Welding Engineer

PIONEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

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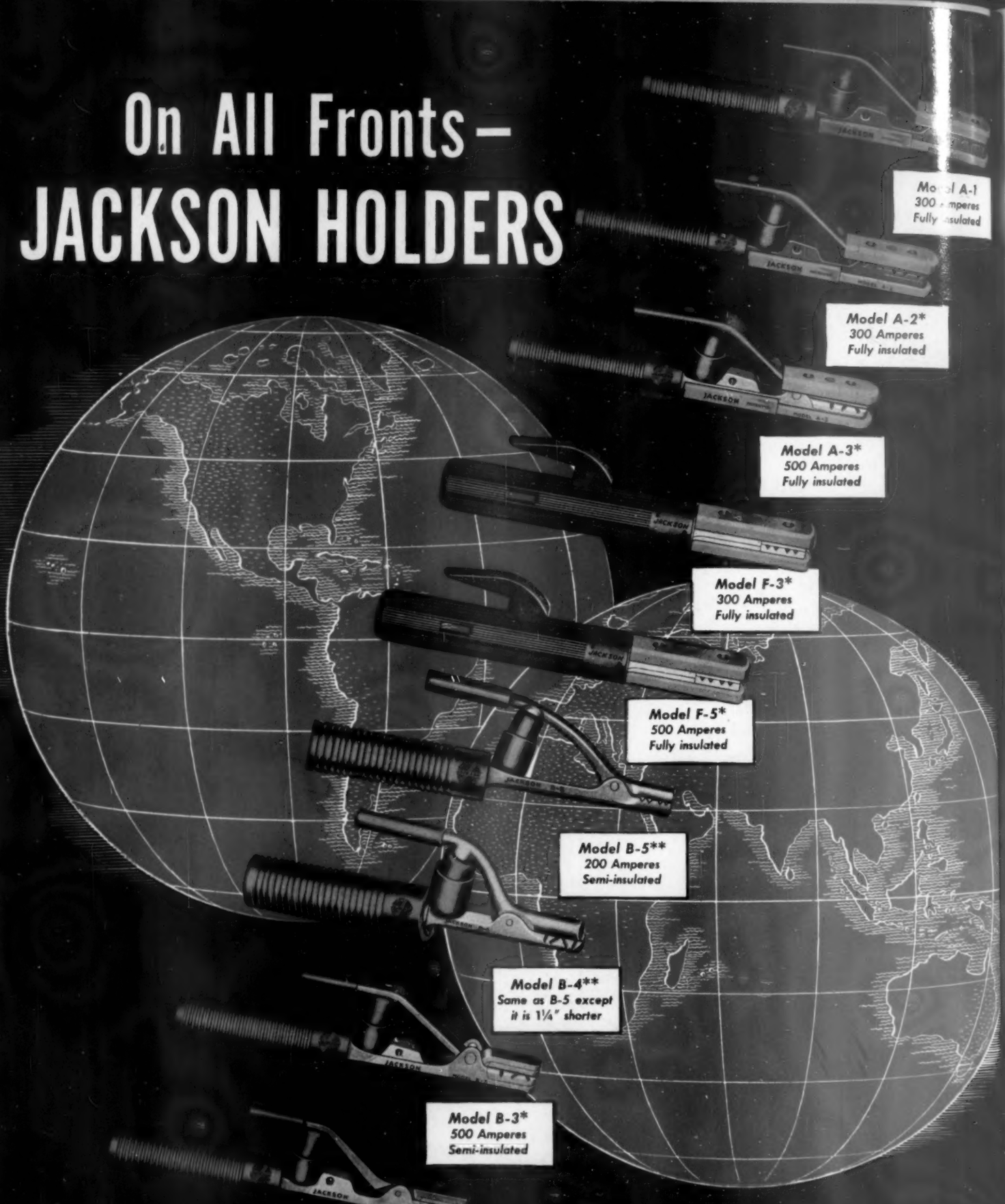

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IN THIS ISSUE

ARTICLES

Current Measurement—I 27
C. M. MANZER and H. S. DAY

Metallurgy's Part in Welding 30
M. G. SEDAM

Welding Speeds Lathe Output 32
H. A. OLDENKAMP

Tractor Parts "Kept Rolling" 36
J. A. CUNNINGHAM

Redesigning a Bar Stool 40
ERNEST REISS

Welding in the Railroad Shop 41
ARTHUR HAVENS

Tubular Structures Portable 45
H. S. CARD

Limitation Order L-146 47

What's Here 11
Editorial 25
Portable Mechanical Drive 35
Welding and Skin Troubles 44
New Ring at One-Third Cost 46
Brief Sketches of Welding Jobs 52
Engineering Data Sheet No. 22 57
New Product Developments 59
News of the Industry 63
Personals 63
Current Reviews 65
Recent Patents 69
Classified 81
Advertisers in This Issue 82

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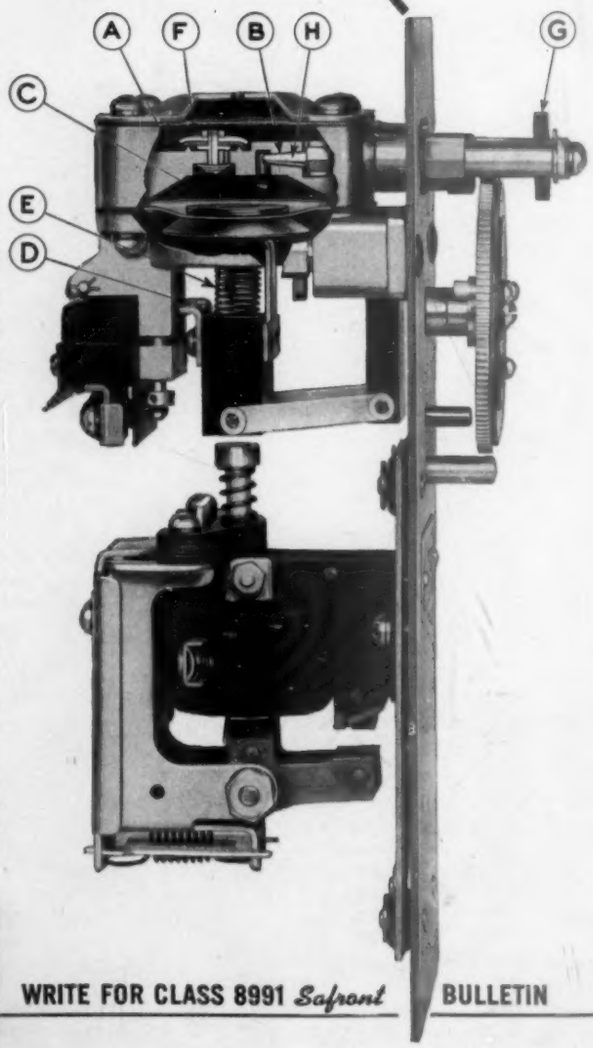
Safront Pulsation Weld Timer illustrated above has six timers controlling SQUEEZE, HEAT, COOL, WELD INTERVAL, HOLD and OFF periods, respectively. COOL period timer has been removed and enlarged to show construction. High-speed control relays used in the system are mounted on rear of protective panel which swings forward for inspection or maintenance. There are 18 NEMA standard types of Weld and Sequence Timers of similar construction.



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The Welding Engineer

AMERICA'S
PIONEER
WELDING
JOURNAL

JULY
1942

Established
1916

Give Me Liberty...

In July the thoughts of Americans always turn back to a July of long ago—a July in 1776, when a group of our forefathers pledged their lives, their fortunes and their sacred honor to rid the colonies of British tyranny.

Tyrannical powers were smashed at that time, but tyranny was to rise again. Again and again the tyrant has sought to suppress our freedom; each time the tyrant has failed.

Now, for the seventh time in our country's brief span, we are at war. Free men are fighting brute force, barbarism and such destruction as has never been experienced heretofore in a civilized world. Amidst bloodshed, unrest and suffering, we find ourselves fighting on the threshold of brighter and nobler times.

The inspiring and prophetic words of Thomas Jefferson, who gave us the Declaration of Independence, are our challenge to fight on to maintain the American way of freedom.

Shortly after the signing of the Declaration of Independence, Jefferson wrote:

> "I shall not die without a hope that light and liberty are on a steady advance. Even should the cloud of barbarism and despotism again obscure the science and liberties of Europe, this country remains to preserve and restore light and liberty to them. In short, the flames kindled on the 4th of July, 1776, have spread over too much of the globe to be extinguished by the feeble engines of despotism; on the contrary, they will conserve these and all who work for them."

The world today is a changing world, and America must lead the way. We must carry light and liberty to those who by ignorance or weakness have become enslaved in the darkness of tyranny. Our way of life must become the way of life of mankind so that peace and freedom will endure.

This must be our goal in the great struggle. Our leadership has already made our way of life the goal of the millions of men of other nations who have known only oppression and poverty. To them, the thought of freedom—a new way of life—gives the courage and inspiration needed to endure the days of darkness and despair which must lie ahead.

Winning the war will not be easy. But when times become desperate, we all should turn to the diary of a soldier who died at Chateau-Thierry—an Iowa lad, whose name I can't recall. On one of its pages he wrote:

> "America must win this war. Therefore, I will work; I will save; I will sacrifice; I will endure; I will fight cheerfully and to the utmost; as if the whole issue depended upon me alone."

T. B. Jefferson

Here's how we can weld 70% FASTER with 30% LESS WELD METAL

That's firing both barrels at the Axis—saving both Time and *Materials.*

ALTER EGO: And it looks like this "Fleet-Fillet" Technique does both by simply getting greater penetration at the corner of the fillet.

Sure, that's the whole secret. That technique requires less deposited metal to produce a weld of given strength. Think how many thousands of man-hours and tons of electrodes it will save on this cargo vessel alone!

ALTER EGO: But how do we go about using it?

Simple. Just use the proper ¼" electrode, use the "Fleet-Fillet" Technique as the bulletin shows, and boost the welding speed. It's the same on ships, guns, machine tool bases, frames—any fillet welds in mild steel.

ALTER EGO: Every welding American should digest Lincoln's 16-page Bulletin on "Fleet-Fillet" and use this double barreled offensive as his personal prod for Victory.

ALTER EGO: Literally, "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

then I said to myself—

THE LINCOLN ELECTRIC COMPANY
CLEVELAND, OHIO

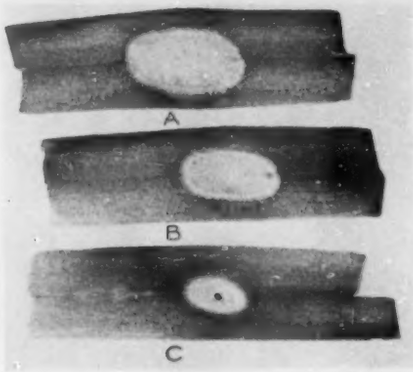


Fig. 1 — Resistance Seam Welds on Type 316M Stainless Steel (⅛ in. thick) showing effect of varying current with all other factors held constant. (A) 109% current, (B) 100% current and (C) 91% current.

Current Measurement Improves Welding Technique

By

C. M. MANZER and H. S. DAY
General Electric Co.

★Part 1—The effectiveness of resistance welds depends upon proper current values. Yet currents that flow for only a few cycles can't be measured with conventional ammeters. What instruments can be used?

WELDING ENGINEERS agree that the most important single item in a good weld is the proper welding current; yet there is seldom found a machine equipped with an instrument for measuring welding current. Isn't this an unusual situation?

Experience has shown that when the variables which enter into resistance welding are properly controlled, the process is put on a more firm foundation with reductions in cost and spoilage, as well as an improvement in the product. Work may be transferred from one machine to another, from development shop to production, and previous good work can be duplicated.

This article discusses some factors which cause variation in welding current, and describes the use of pointer-stop ammeters, which have been found invaluable for providing facts needed for proper control of spot and projection welding consistency.

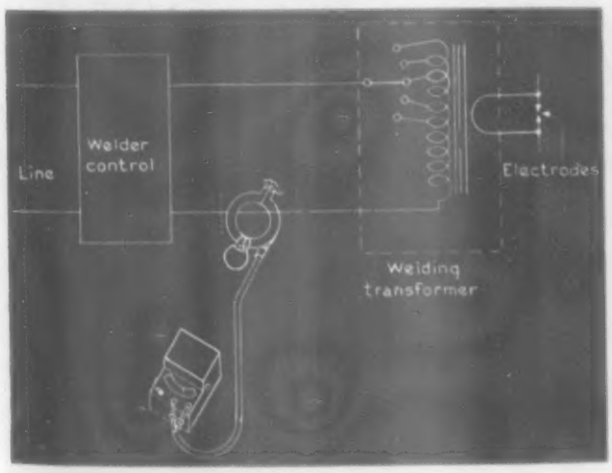


Fig. 2—Schematic diagram — Measurement of welder current with split-core transformer and pointer-stop ammeter.

Although other specialty instruments for this purpose are available, a discussion of them is not within the scope of this article.

Welding Current Magnitude

The heat energy in a weld varies as the square of the current. Thus, if the other factors are constant, a small variation from the optimum current results in much larger deviation from the proper heat. If the current is too high, the work may be burned and the surfaces marred; if the current is too low, there may not be sufficient heat to properly fuse the metals and a weak joint may result.

This is shown more vividly in Fig. 1, which indicates possible variation in the weld area resulting from a plus or minus 9% change in welding current.

With any one welding machine, results cannot be duplicated by simply replacing the electrodes and fixture previously used, and setting

Fig. 3—Switchboard type pointer-stop ammeter being used to measure the current employed in resistance welding.

the machine for the same heat, time, and pressure *unless* the "loop area"[1] is exactly the same as above. In the average welding machine, the adjustment of electrodes to change the loop area from maximum to minimum may result in as much as 35% change in secondary current. Fluctuations in power supply voltage will cause additional variations in the welding current.

Most resistance welding machines are provided with some form of control to give a number of "heat" settings. This control may be taps on the welding transformer primary, or, in the case of an electronic control, a means of varying the point on the voltage wave at which current starts to flow to the transformer. In all cases, these heat settings do not give an indication of the current which will flow when a weld is made.

A recognition of the difficulties involved in accurately controlling the important variable, welding current, resulted in an investigation of a simple and practical means of measuring the secondary amperes used in welding.

Measurement Welder Current

Conventional Instruments—Since conventional ammeters require approximately 1 to 2 seconds to reach a final indication, such instruments are not suitable for the usual measurements where the current flows for only a few cycles. An oscillograph[2] can be used for such work, but in addition to not being well adapted to use in the shop, its practicability is impaired by the need for an experienced operator, and the relatively high price.

Pointer-Stop Ammeters—For a long time, ammeters provided with an adjustable stop arranged to push the pointer up-scale have been used in measuring current of short duration. Such instruments are provided with an external knob for use in manually setting the pointer to any scale value. To take a reading, the user should first set the pointer to the approximate current expected. If, when a weld is made, the pointer "kicks" up-scale, the setting is too low, and the stop should be readjusted until the pointer barely moves away from the stop when the current pulse occurs. The ammeter then reads RMS current for the last weld. Anyone capable of reading conventional instruments can use a pointer-stop ammeter.

A typical portable pointer-stop ammeter is shown in Fig. 4, and a switchboard type, mounted on a welder panel, in Fig. 3.

Use of Pointer-Stop Ammeters—Extensive tests[3] have now proved that pointer-stop ammeters are entirely suitable for measuring welding currents of 3 cycles or more duration (60 cycle system). Accuracy of within plus or minus 5% of the ammeter full scale rating can be obtained, regardless of whether heat control is by taps on the transformer or phase control. In the case of non-synchronous timing, a pointer-stop ammeter will frequently indicate the undesirable large transients which occur if the welding transformer is energized at a time other than at which the voltage wave is passing through zero.

Since the current used for welding is usually high, it is customary to employ a current transformer in connection with an ammeter calibrated either in terms of welding transformer primary or secondary amperes. Although special current transformers rated 50,000 amp. maximum are available for use in the secondary circuit of the welding transformer, this arrangement is not considered generally practical because of difficulties involved in connecting the transformer in the welding current circuit. Therefore, it is customary to determine the welding current by measuring the primary current, and multiplying this by the ratio of transformation.

For permanent installation, a standard current transformer may be used; for portable service, a split-core current transformer, with an instrument calibrated in primary

Fig. 4—A portable transformer-rated ammeter with pointer stop for welding service.

[1] The term "loop area" refers to the area of the space bounded by the conductors through which the welding current flows; i.e., the area enclosed by the transformer secondary, electrodes, leads from transformer secondary to the electrodes and metals being welded.

[2] See The New Oscilloscope—an Aid to Good Resistance-Welding, THE WELDING ENGINEER, Aug., 1941.

[3] Resistance-Welding Current Measurements by E. W. Clark, *Welding Journal*, Mar., 1940.

Fig. 5—A split-core clamp-on type of current transformer which is quite valuable in measuring welding currents.

amperes, allows measurements to be made by merely clamping the transformer around one of the primary cables (Fig. 5).

Table I — Portable Pointer-Stop Ammeters — Standard Ratings

Rating Amp.	Scale Marked	Readable Current Range—Amp.
	For Use with Portable Split-Core 200:1 Type G-4 Transformer 25-125 Cy.	
.5/1.5	100/300	30 to 300
.75/1.5	150/300	50 to 300
1.25/2.5	250/500	100 to 500
3/6	600/1200	200 to 1200
3.75/7.5	750/1500	250 to 1500
	For Use with Other Current Transformers Having 5 amp. Secondary	
5	In accordance with trans. ratio	Down to approx. 1/3 full-scale current

Selection of Pointer-Stop Ammeter Equipment—Normally a portable ammeter and a split-core transformer are used for checking purposes, or where several machines handle one product continuously. It is then desirable to check occasionally to see that the welding current is consistent.

Standard portable pointer-stop ammeters, designed for use with split-core current transformers in measuring welder primary current, are listed in Table I. The ammeters are provided with a toggle switch for convenience in changing ranges. Similar ammeters for use with conventional current transformers are also available.

If the welding machine is to be used for a number of jobs requiring different current values, or if the machine adjustments are to be changed frequently, a switchboard ammeter and current transformer should be permanently installed, so as to be always available for immediate use. A typical installation is shown in Fig. 3. The switchboard type ammeters are normally rated 2-1/2/5 or 5/10 amp., depending upon the current transformer rating. For best accuracy, readings should be taken in the upper 2/3 of the scale range.

Part 2 will appear in August.

★

Editorial Staff Increased

CLYDE B. CLASON, a native of Denver, Colo., has joined the editorial staff of THE WELDING ENGINEER. Mr. Clason, who is to be Associate Editor of THE WELDING ENGINEER, assumed his new post on June 17.

Some 13 years' experience in business paper journalism, 1 year in advertising, 3 years as a free lance fiction writer have prepared Mr. Clason for the important position he now occupies. He is a graduate of the University of Denver, class of 1925, A. B., where he majored in economics.

Mr. Clason has been engaged in editorial work since 1926. His first editorial position was as assistant editor of *Electric Light and Power*. For thirteen years he worked on this journal and on its companion publication, *Electrical Dealer*, both published by Electrical Publications, Inc., Chicago.

In 1937 Mr. Clason migrated to Southern California, where he spent three years in the writing of detective stories. During this period he wrote ten detective novels concerning the adventures of the little sleuth - savant, Theocritus Lucius Westborough, which were published in book form by the Crime Club Division of Doubleday, Doran & Co.

CLYDE B. CLASON

In September, 1940, Mr. Clason rejoined the staff of Electrical Publications, Inc., as managing editor of *Electrical Dealer* and news editor of *Electric Light and Power*. He now brings to THE WELDING ENGINEER a broad background of information regarding the electrical industry and the abilities of a trained and thoroughly seasoned writer that will further strengthen the editorial content of THE WELDING ENGINEER.

As associate editor, Mr. Clason will prepare feature articles and news stories relating to important developments in the welding industry. Through this addition to its staff, THE WELDING ENGINEER will be able to bring to its readers more and better exclusive articles, covering all phases of welding, cutting and related applications.

Metallurgy's Part in Welding

By M. G. SEDAM

Metallurgist, Electrode Div.,
Harnischfeger Corp.

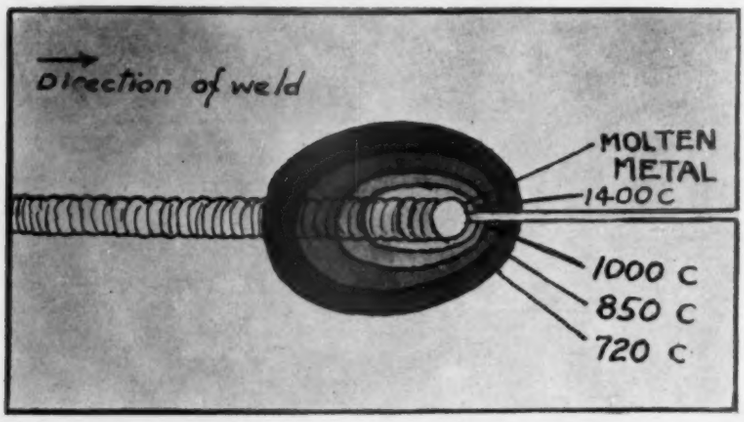


Fig. 1—Single pass weld used to join two plates of low carbon steel. Metal directly beneath arc is molten, exceeding 1524 C. Temperatures in outer zones reach the figures given.

★

The changes in properties as metals are heated and cooled are of vital concern to weldors. In this article, a leading metallurgist tells how temperature changes occurring through the arc welding process may be correlated to changes in properties of the weld.

IN THE LAST WAR, electric arc welding was an infant—a new tool for industry with a promising future—but still in the laboratory stage. There was much to be learned about it—more about its applications. But how welding has grown since then! Today, in World War II, it has become one of the gigantic tools of production for war. Think for a moment of the vast role it is playing in making guns and tanks and battleships and bombers—not overlooking its part in building the machines by which these implements of war are made. Even the immense factories which house these machines are built with the aid of welding.

In the time between World Wars I and II, arc welding has become so thoroughly established as a tool for fabrication and repair, that to the casual observer, it has become almost commonplace. However, as most of us know, this gradual change to arc welding has brought with it many new problems. To the weldor, it has meant long hours of practice to master the proper technique. To the design engineer it has meant much calculating of stresses, figuring of permissible loads and determining of safe working values. To the management, it has meant the expenditure of large sums of money for new equipment, new problems for superintendents and works managers, and new calculations of costs. Besides these problems to the weldor, the design engineers, and the management, to the metallurgist has come the task of searching out metallurgy's part in welding.

One phase of metallurgy has to do with the change in properties of metals as they are heated and cooled. Essentially, the welding process is the joining of two pieces of metal by heating the metal above its melting point, usually with the addition of metal of a similar chemical analysis. Consequently, metallurgy is an important aid to welding. Through metallurgy we are able to interpret the temperature changes during welding and to correlate these changes to those in the structure and properties of the joint.

Let us examine what takes place when a single pass weld is used to join two plates of low carbon steel, (Fig. 1). When an arc is struck, the metal directly beneath it instantly becomes molten, reaching a temperature in excess of 2800 F. At the same time the core wire temperature of the electrode has exceeded its melting point and filler metal begins to deposit on the plates. This deposit is in the form of a molten pool, sometimes referred to as the weld melt. As the weld progresses, the arc is moved from its initial point of contact, and this initial point loses its source of heat. Heat is removed through conduction into the plates and through radiation into the air. Finally, the temperature of the metal at the initial point falls below its freezing temperature and the metal begins to solidify. Thus in the space of a few seconds the temperature of the metal has been raised from room temperature to above its melting point and then allowed to fall back to below its freezing point.

At the same time the temperature of the two plates adjacent to the weld have been heated to varying temperatures depending upon the distance

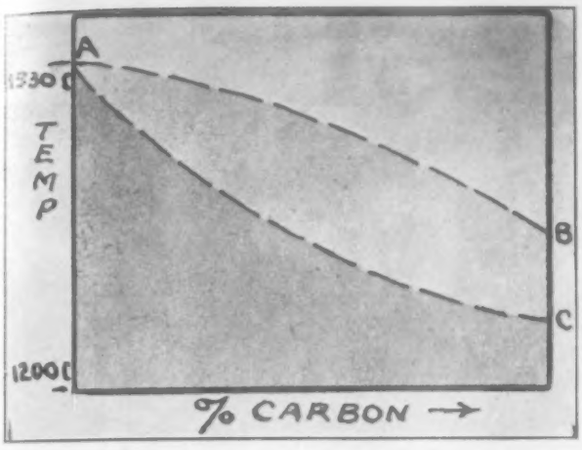


Fig. 2—An iron-carbon alloy (steel) freezes over a range of temperatures. The alloy is liquid above the line AB; partially solid and partially liquid in the area between lines AB and AC. Not until the temperature drops to the line AC does the alloy become competely solid.

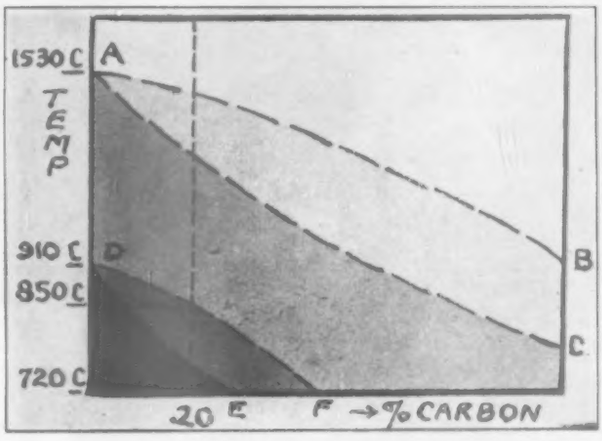


Fig. 3—A change takes place in the crystal structure of iron at 910 C, enabling iron heated above this temperature to dissolve carbon. Point D represents the critical temperature, 910 C, and line DFE indicates that this change, like the solidifying of the metal, also extends over a range of temperatures.

from the weld. Nevertheless, any portion of the plate heated to a temperature above 720 C. (1328 F.), will be affected by the weld.

Freezing Range for Steel

Why is this temperature level the dividing line between affected and unaffected portions? It is because pure metal freezes at a definite temperature; aluminum freezes at 659 C.; copper freezes at 1083 C.; and iron freezes at 1530 C. Steel, however, is essentially an alloy of iron and carbon. When carbon is added to iron to form steel, it lowers the melting point of the iron, and at the same time causes the iron to freeze, not at a definite temperature, but over a range of temperatures as shown in Fig. 2.

Point A (Fig. 2) represents the melting point of pure iron. As carbon is added to the pure iron, the freezing or solidifying temperature of the resulting alloy is lowered, as indicated by the line AB. Above line AB, the alloy is liquid. Below line AB, the alloy is not solid, but partially solid and partially liquid. Not until the temperature reaches line AC is the alloy completely solid. Thus in the area between lines AB and AC solid crystals and liquid are present at the same time. Due to a peculiar property of iron, a change takes place in its crystal structure at 910 C. (1670 F.), above this temperature iron is able to dissolve carbon. Below this temperature it loses this ability, and carbon is precipitated out as a compound of iron. The temperature at which this change in crystal structure takes place in the solid iron is effected by carbon, similar to the lowering of the melting point. This is shown in Fig. 3.

Varies with Added Carbon

Point D represents the temperature, 910 C., at which the change in crystal structure takes place. This temperature may be depressed by additions of carbon as shown by line DE. Line DFE indicates that the change in crystal structure is not accomplished at a single temperature. Like the solidifying of the molten metal, it requires a range of temperature to obtain this result. Line FE is at 720 C. No change in structure will take place between 720 C. and room temperature. Thus, we see that only that portion of one welded sheet which has been heated above 720 C. will be affected by the weld. The portion heated between 720 C., and 850 C., which is a point on line DF, Fig. 3, will show some change in structure because the steel in this portion has undergone some change in crystal structure. The portion heated above 850 C., will show definite change. In passing through 850 C., the steel will transform its crystal structure. The grain at this point will be very fine. As the temperature is increased above 850 C., the small, fine grains will combine to form fewer large grains. The higher the temperature, the larger the grains. Thus it follows that those portions of the welded plates which have been heated above 850 C. will have larger grains the closer they are to the actual weld. This change in grain size of the plates adjacent to the weld is shown in Fig. 4.

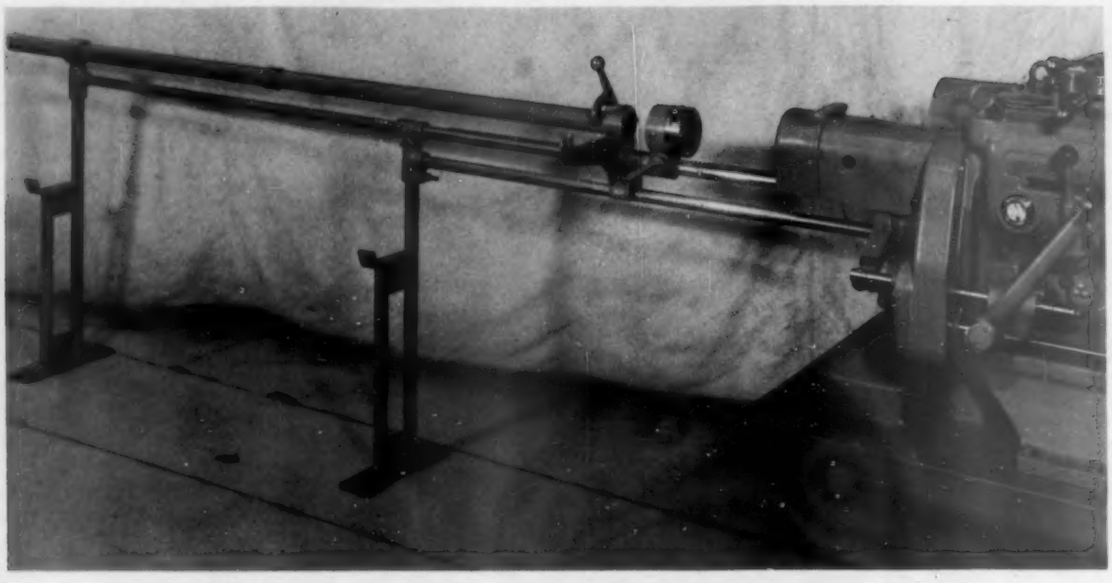
The weld metal will appear as a cast or dendritic structure of fairly large grain size.

Coarse Grains Refined

If we had started with plates which were thick enough so that a two pass weld were required, a slightly different structure would exist in the weld metal. As the temperature of the first pass would be raised through 850 C., by the advancing second pass, each coarse grain of the first pass would change to numerous fine grains. During cooling the fine grains in the first pass would transform at 850 C., to still finer grains. Thus a two pass weld in mild steel consists of a fine grained lower bead and a coarse grained upper bead. If the weld were made in more than two passes, each succeeding pass would refine the preceding pass and the proportion of fine grained material would increase.

Finer grained material has a higher ductility than a coarse grained material. Consequently, the two or more pass welds will have superior ductility over the single pass weld.

Fig. 4 — Changes in grain size of metal adjacent to a weld. Above 850 C, the small, fine grains combine to form larger grains.



One important change from cast iron to welded steel has been the bar feed stands (Figs. 4 and 5).

Welding Speeds Lathe Output

By

H. A. OLDENKAMP

Welding Consultant,
Warner & Swasey Co.

SIX MINUTES to sixty seconds! A remarkable feat showing that it *can* and *must* be done!

This reduction in time was made recently in the welding of expansion collars in the coolant pans of Warner & Swasey turret lathes. The time formerly given our weldors was six minutes, including set-up, for welding each 2½ in. diameter collar. Merely by changing the steel specications from SAE X1315 to SAE X1020, changing the type of electrodes used and putting the job in a shop accustomed to high production welding, the time was cut to less than one minute for each collar. SAE X1315 steel, high in sulfur, is fine for machining, but is very difficult to weld at a high production rate because of the high sulfur content. A change to SAE X1020 steel enabled the operators to use large diameter, heavily coated electrodes at much higher currents than previously used, thus accounting for a large share in the reduction of time.

Production Possibilities

Examples such as the one above are evidence that we in the welding field have not as yet "scratched the surface" of the possibilities for high production welding. In order to speed up the tempo of welding, let us consider the effects of (1) Design, (2) materials, (3) tools and (4) welding personnel.

Better parts, faster and cheaper, is the welding story at Warner & Swasey. Turret lathe parts were redesigned so that production may be speeded through the use of welded steel construction to replace former cast iron construction.

Design is probably the most important factor in the cost and time of welding. Because of the fact that there are few handbook rules and tables on this subject, a designer not only must be thoroughly familiar with actual welding procedures and methods of welding, but also must have a fair knowledge of the functions of the machine for which he may be designing various parts.

Although steel in general is more difficult to machine than cast iron, in some cases the use of rolled steel actually decreases the amount of machining on a part. Combining several parts, which were formerly bolted together, into a welded structure eliminates the necessity for drilling, tapping and milling the faces to be bolted. Oftentimes, rolled steel as obtained from the mill provides a surface smooth enough for motor

mountings, brackets, electrical controls, etc., whereas it was formerly necessary to mill or plane mounting surfaces.

Using these basic ideas, a few design examples follow:

Fig. 1 shows a cast iron vertical motor base which was originally used on many of our machines, and to all appearances was a well designed piece of cast iron. Notice that it was necessary to plane the surface of the base, because the rough casting surface was too uneven to provide a motor mounting.

Welded Motor Base

While other changes were being made on the machine it became necessary to redesign the base; so, our engineering department chose the welded steel base shown in Fig. 2. Later, it was found necessary to increase the size of the base to accommodate larger motors and the control apparatus for the motors—without materially increasing the cost of the base. Obviously, the base in Fig. 3 requires more material; however, this increase in material was somewhat offset by using ½ x 2 in. diagonal braces (A1 and A2 in Fig. 3) instead of the solid diagonal plate braces as shown in Fig. 2. The welding time (arc time) was reduced 28% by using the ½ x 2 in. diagonal braces, without reducing the rigidity. In addition, by cutting down on the amount of welding on the base, warpage in the ⅝ in. thick plate is kept to a minimum.

It is well to remember redesign points of this nature. In this instance, welding time was reduced, as was warpage, while rigidity was maintained.

The plate used for the motor base was found to have a satisfactory finish for mounting motors, and it was therefore unnecessary to plane the face of the plate as was done with the cast iron base. The cast iron part weighed 210 lbs. as compared to 171 lbs. for the final steel design shown in Fig. 3, the steel design actually providing more space for mounting the motors and controls.

Cost Reduction

On the basis of present day prices for cast iron and steel, a cost saving of about 50% was realized in this motor base change-over. Then, too, machines formerly used for machine work on the cast iron base were released for other badly needed work.

Welded Bar Stand

Another change to welded steel has been the bar feed stands. Fig. 4 shows the old design and Fig. 5 the new. The new design eliminates the necessity of threading the pipes and tapping the base and support as can be seen by comparing the two designs. The pin in the cast iron support is of course also eliminated. Previously, the long pipe in Fig. 4 had to be purchased with a certain tolerance on the O.D., because it had to slip through the support. However, with the new welded design the pipe limits do not have to be held and a less expensive grade of pipe can be used.

An accurate cost comparison is not available on the bar feed stands, because the old design was made in our shop, whereas the new design is now being made by a sub-contractor. However, even with the sub-contractor's profit figured into the cost, the cost for the new design of one particular stand is about the same as for the old. On another type of stand a saving of 15% to 20% is being made including the sub-contractor's profit. While this may not seem like a great cost advantage, nevertheless, the machines and labor tied up in making the old stands were released for more valuable work; at the same time we were able to purchase the new stands at an appreciable over-all saving.

In times like these, the fact that the work was in the hands of a sub-contractor meant greater production from existing plant equipment; this is a savings in itself.

Recently, by eliminating certain parts on the belt guards of the Warner & Swasey A-type machines several hours assembling time were saved. Previously, the guard was assembled to a cast iron spider which in turn was assembled to the machine. By incorporating the spider as a welded sheet metal part of the guard, the cast iron spiders were eliminated. The comparative designs of the old and the new guards are shown in Fig. 6 and 7.

Parts Eliminated

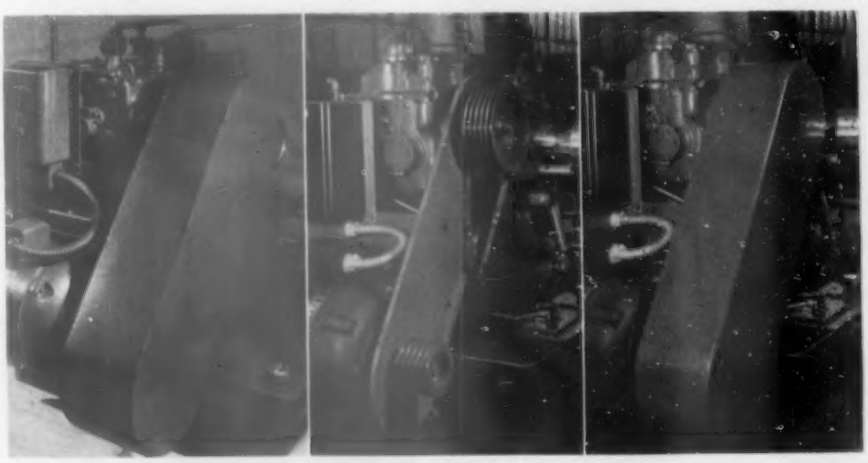
There was also removed the steel strap bracket which was previously located in assembly and then riveted to the guard. The guards are now supported directly to the edges of the motor bases by means of screws through the holes in the back plate of the guard.

The new belt guard design has reduced the over-all cost 25% to 30% and decreased assembly time on this part from 4 hrs. to approximately ½ hr. Besides the cost advantage, the appearance of the guards has been enhanced, better protection from the belts has been provided, there is a more convenient way for getting the belts on and off the sheaves and there has been a standardization of guard sizes so that one size guard is suitable for a majority of all the drives and motors put on machines.

Other Welding Applications

Other parts which have been successfully welded for a number of years are the oil and coolant pans, splash guards, apron covers, special brackets, etc. The welding of machining jigs and fixtures has increased steadily in our shop to a point where there is hardly a jig or fixture made which does not have some welding on it, if it is not a completely welded unit.

The importance of using the correct material for welding has al-



Former belt guard (left). This was assembled to a cast iron spider, in turn assembled to the machine. Present belt guard (center and right) is shown with and without cover. (See Figs. 6 and 7.) Note method of mounting to motor base

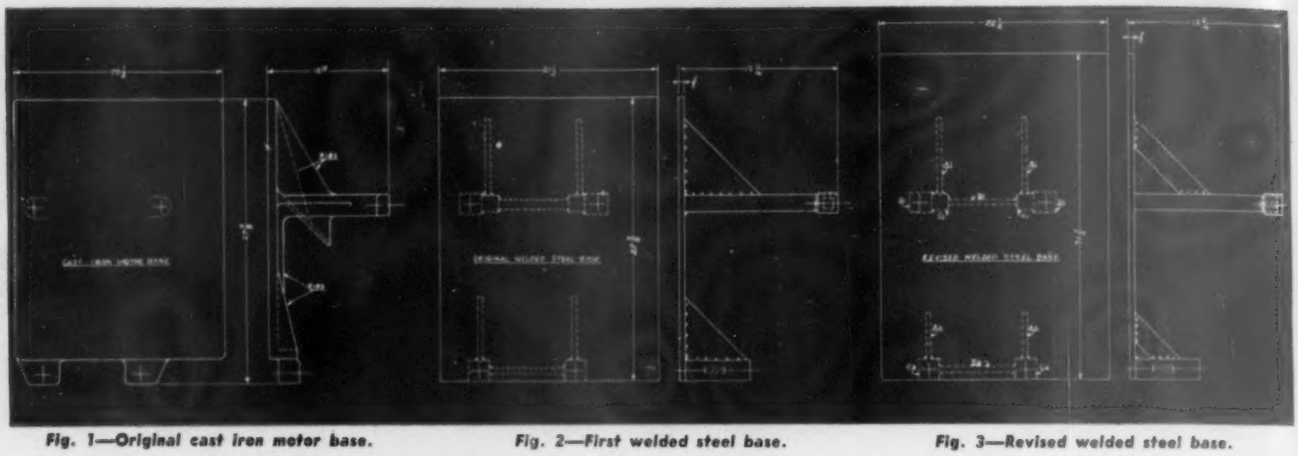


Fig. 1—Original cast iron motor base.

Fig. 2—First welded steel base.

Fig. 3—Revised welded steel base.

ready been emphasized. However, it is also important that the material be applied correctly in a design so as to use the minimum amount of welding and forming.

No More Rivets

This point, as well as the elimination of rivets, is shown in Fig. 8, which covers the spindle rack used extensively in the plant for handling shafts and spindles. The copper straps, which were formerly 2¼ in. wide and riveted to the steel, are now made only ¾ in. wide saving ⅔ of the copper. This was made possible by welding the straps to the steel, thus saving considerable tool room time in drilling and riveting the straps to the steel.

Under the category of welding tools, probably the most important is the welding electrode. The proper size and type should always be decided upon for every job. The largest diameter electrode possible should be used. By going from a $\frac{3}{16}$ in. to a ¼ in. electrode, it can be shown that the cost per pound deposited can be reduced 35% to 40% with a corresponding decrease in the welding time.

The proper size and type of welding machine should also be considered carefully for each job. If there is some doubt about the most suitable machine, a reputable welding machine manufacturer should be consulted for his recommendations and help. In general, the use of AC arc welders has been found most suitable for fillet work and for machine bases which can readily be positioned for down-hand work. DC variable open-circuit voltage and variable current machines are best suited for vertical, overhead and general purpose work.

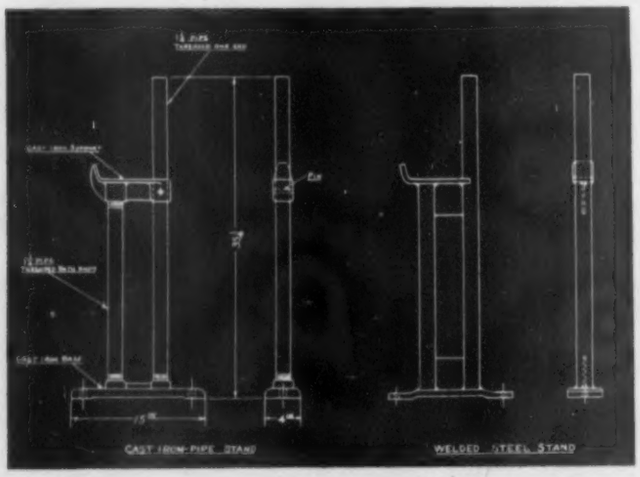


Fig. 4 (left) — Old design of cast iron bar feed stand.

Fig. 5 (right)—New welded steel bar feed stand. See also the picture at beginning of this article.

Jigs and Fixtures

Jigs and fixtures are another very important welding tool. Production welding can be speeded up considerably by the use of simple jigs and fixtures for holding the parts to be welded. As an example, examine Fig. 3. The parts, A1, B1, C1, and D1 can be welded as a sub-assembly after first being tack-welded in a small fixture. Likewise, A2, B2, and C2 can be welded as a sub-assembly. The sub-assemblies are then laid on the ⅝ in. thick plate and tack-welded in place using a third simple locating fixture, and finally securely welded to the plate. This method not only provides a quick way for locating the parts, but the sub-assemblies are easy to handle and can be welded by a man sitting at a bench. In the old method where all the parts were first tack-welded together on the ⅝ in. plate, it was necessary for the plate to be lifted up into various positions in order to make all the joints accessible, necessitating the

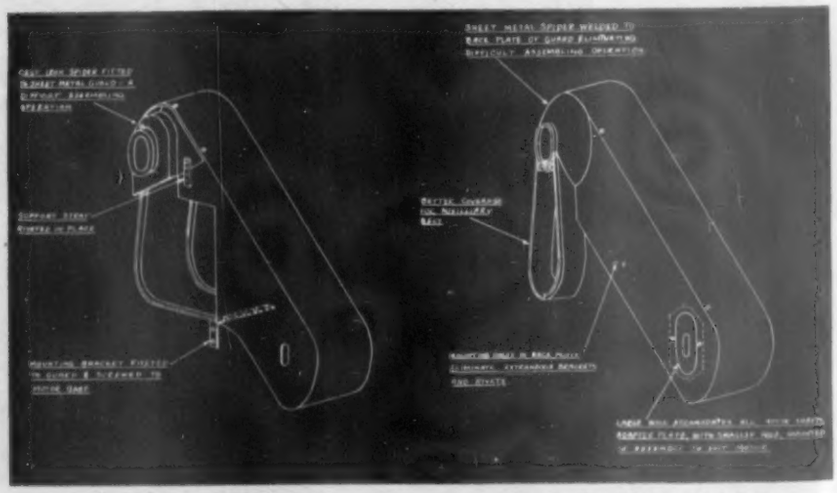


Fig. 6—Old belt guard design.

Fig. 7—Simplified welded design.

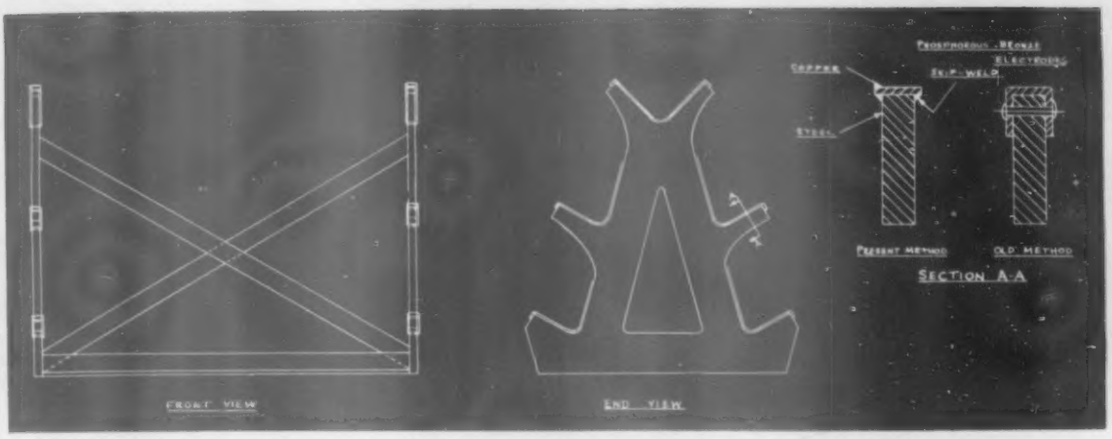


Fig. 8—New spindle rack. Copper straps were made smaller and welded instead of riveted to steel.

use of two men on the job, or one man and a crane. With the new subassembly method, it is only necessary to move the whole assembly after it has been completely welded.

By the use of this method of fabrication, the time for welding the motor bases was reduced from 1 hr. to 35 min.

Personnel Development

An active personnel development program would be helpful in a welding department. Arrangements should be made by the welding supervisor to have meetings at least once a month with all the operators collectively. The purpose of these meetings should be to stimulate the welders into thinking about methods of increasing their efficiencies as well as ideas for new designs. At these meetings the welding supervisor should bring to the men new ideas and methods introduced by other companies and men outside the plant, illustrating with slides and movies if possible.

Welding Attitude

The proper attitude on the part of the welding department personnel must be maintained. Inasmuch as welding is a relatively new process for fabrication, many ideas for new designs often originate in the welding department. Each man in the department must be open-minded to try new procedures and methods to speed up the welding, and very often make the job easier for himself. Frequently, welding operators who have had only little experience are quite suitable for production welding, because they will usually keep their minds open to suggestions for improvements.

For ordinary production work not requiring code or government inspection, it is not necessary or advisable to qualify operators before hiring them. As a matter of fact an inexperienced operator is usually easy to train on a repetitive job and will stay with it providing his pay is advanced commensurate with the increase in his knowledge and experience.

In conclusion, it can be seen that low welding costs and high production are affected by many conditions, and unless each and every department is handled efficiently, the best advantage cannot be realized.

Portable Mechanical Drive

By **JOHN S. GREEN**

In the fabrication of heat exchanger shells, or other cylindrical bodies, a smooth working mechanical drive is a requisite while arc welding the circumferential seams. As demands for increased production grew in the welding department at the Johnson & Jennings Co., Cleveland, Ohio, it became evident that serious limitations in floor space and crane capacity had to be relieved. The addition of the conventional types of power driven rolls for welding would add to, not diminish the floor space.

To solve the problem, a portable mechanical drive was needed that could be placed in position quickly when and where required. This unit would eliminate the use of cranes for transferring the shells from the original set-up position. Also, a mechanical drive could be moved easily from shell to shell as the requirements of welding operators call for its use.

The base for this home built portable mechanical drive was built from welded channels. It was supported by three cast iron wheels mounted on roller bearings for portability. Single guiding wheel was mounted on a cam-controlled by the pulling handle. This cam placed the bottom of the base on the floor when the drive was not in use. The two rolls, used to revolve the shells, were mounted on a welded steel platform—raising or lowering actuated by a hydraulic cylinder through telescoping levers attached to the base and platform.

Drive mechanism consisted of a 1 hp. reversible motor connected to a differential gear reducer unit, driving through a variable speed gear reduction unit which was joined by roller chains to the shafts on which the rollers were mounted. The motor was fitted with reversing switch and extension cord in order to permit the welding operator to control shell movement through a push button switch located conveniently near his work. This efficient mechanical drive was designed and built in four weeks at a shop cost of $675.

Photo Hobart Bros. Co.

New drive built for Johnson & Jennings Co.

Tractor Parts "Kept Rolling" with Arc Welded Repairs

By J. A. CUNNINGHAM
Welding Application Engineer,
Arcway Equipment Co.

Fig. 1—When bottom rollers become worn (left), they can be restored to better than original usefulness by rebuilding (right) with welding and hard-facing.

THE NECESSITY for conserving steel for our war effort has made arc welding a means, more valuable than ever before, of quickly and inexpensively maintaining tractors, shovels, and other types of heavy machinery. This process has, especially in repairing and rebuilding worn or broken tractor parts, found wide application.

The principal advantages resulting from welding are:

1. Iron and steel are conserved to the extent of 90% or more of the weight of the worn parts. (The weight of electrode required for reconditioning seldom amounts to as much as 10% of the weight of the part being repaired.)
2. Valuable time is saved because welding is usually much faster than having to wait for new parts.
3. Reconditioned parts usually wear from 20 to 100% longer than new ones when the right type of electrodes are applied correctly; the deposited metal is harder and more wear-resistant than the original.
4. A great deal of money is saved because the cost of rebuilding by arc welding is much less than new parts (Table 1).

This article will discuss techniques used in rebuilding worn parts of a larger crawler type diesel tractor.

Rebuilding Driving Sprockets

When driving sprockets become worn to the extent that instead of rolling the track bushings begin to slide on the teeth and cause seizing

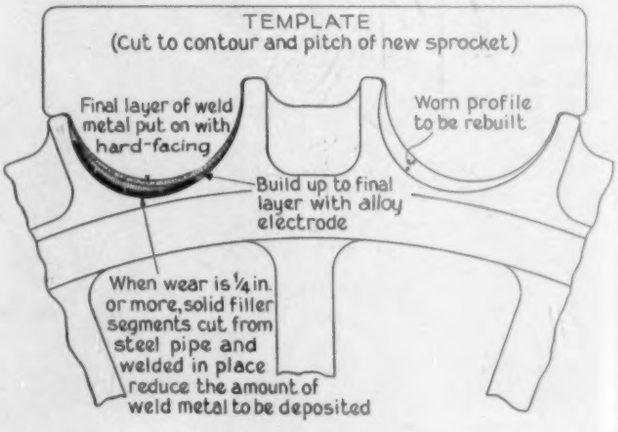

TEMPLATE
(Cut to contour and pitch of new sprocket)
Final layer of weld metal put on with hard-facing
Worn profile to be rebuilt
Build up to final layer with alloy electrode
When wear is ¼ in. or more, solid filler segments cut from steel pipe and welded in place reduce the amount of weld metal to be deposited

Fig. 2—Worn drive sprockets are rebuilt to advantage by depositing metal with the arc welding process.

Rebuilding and repair of worn or broken parts of tractors and other heavy machinery saves time, saves money and conserves iron and steel—to the extent of 90% or more of the weight of the worn out parts.

or galling, tooth contours must be restored to their original shape. Usually this operation can be accomplished without removing the sprockets from the tractor, although the track must of course be removed. Normal procedure involves the use of a template, usually made from ⅛-in. sheet metal and shaped to conform to the pitch and tooth contour of a new or unworn sprocket, as illustrated in Fig. 2.

In case the template shows that no more than one layer of weld metal is needed to restore the contour, the application of a hard-facing electrode will meet all requirements to best advantage. If more than one layer is required, all but the final layer are put in with shielded arc alloy electrode. This procedure provides an inexpensive base of medium hard metal which stands up well under the harder final layer deposited with the hard-facing electrode.

In case the template shows the depth of wear to be more than ¼-in., a piece of solid filler metal may be used to advantage, also illustrated in Fig. 2, in order to reduce the number of layers of weld metal needed to restore the contour. It is common practice to cut such segments from ordinary iron pipe, the outside diameter of which is chosen to fit the curvature of the worn contour and the length of which is equal to the width of the sprocket teeth.

Experience shows that the width of the segment should not exceed

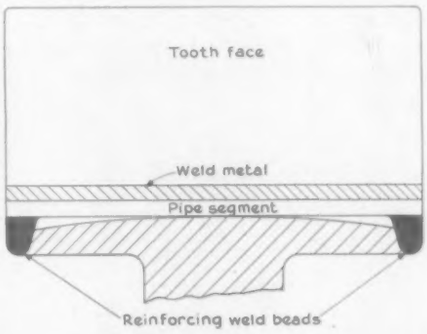


Fig. 3—When extra wear has occurred along the outside edges of the sprocket, a pipe segment ——solid filler metal——is used in rebuilding the tooth contour. Reinforcing beads of weld metal are applied as illustrated above.

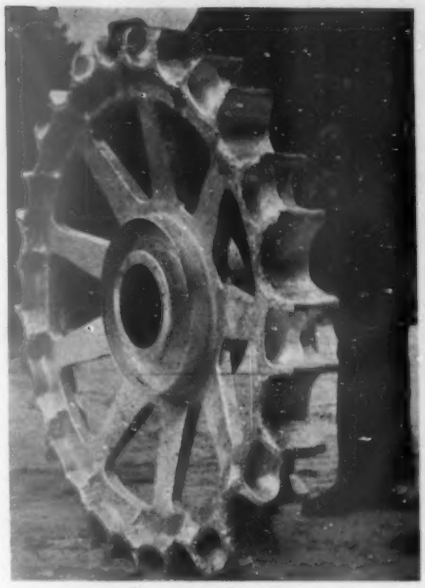


Fig. 4—Ordinarily, driving sprockets are not removed for rebuilding worn teeth. This saves as much time as is required for welding.

1⅜ in. Hence, two or three segments may be used in each contour, spaced about ¼ in. apart to permit welding solidly to the base metal. With filler segments in place, a minimum gap of ⅛ in. should remain for deposit of hard-facing electrode.

Before starting the hard-facing deposit, the segments are welded in place with a shielded arc mild steel electrode. Also, after hard-facing has been completed, it is usually necessary to run a bead between each end of the segment and the sprocket

Table I — Possible Saving by Rebuilding Worn Crawler Tractor Parts by Arc Welding

Tractor Parts	Cost of New Parts	Cost to Rebuild Including Labor (a) and Material (approximate)	Money Saved by Rebuilding	Length of Service Obtained from Rebuilt Parts (b)	Time Required to Rebuild	Weight, Size, and Type of Electrode Required
Driving Sprockets	$179 per pair	$49 per pair	$130	Twice that of new parts	30 hrs. 1 layer high alloy hard-facing 1 layer Manganese alloy h-f.	25 lb. ¼ in. 30 lb. ¼ in.
Bottom Rollers (Set of 12 double rollers)	$240 per set	$36 per set	$204	Twice that of new parts	24 hrs. 1 to 2 layers Ferrous alloy h-f. 1 to 2 layers high alloy h-f.	50 lb. ¼ in. 10 lb. ¼ in.
Front Idlers	$141 per pair	$13 per pair	$128	Twice that of new parts	8 hrs. 1 layer Ferrous alloy h-f. 1 to 2 layers high alloy h-f.	20 lb. ¼ in. 6 lb. ¼ in.
Track Rails only (Total of 144 links for both tracks)	$261 per set	$27 per set	$243	50% more wear than new parts	16 hrs. 1 layer Ferrous alloy h-f. 1 layer high alloy h-f. on edges	45 lb. ¼ in. 10 lb. ¼ in.
Track Grousers (Total of 72 plates for both tracks)	$216 per set	$43 per set (d)	$173	20% more wear than new parts	22 hrs. 2 passes AWS E-6010 1 layer Ferrous alloy h-f.	40 lb. 5/16 in. 14 lb. ¼ in.
Top Rollers (c) (Set of 4 double rollers complete)	$54 per set	$11 per set	$43	40% more wear than new parts	6 hrs. 1 layer Manganese alloy h-f. on face only	10 lb. ¼ in.
Tractor drawing clevis and universal of carryall scraper	$72 for both	$5 for both	$67	50% more wear than new parts	4 hrs. 2 to 6 layers high alloy h-f.	50 lb. ¼ in. 1 lb. 5/16 in.

(a) Labor costs included in this table are based on a rate of $1.00 per hr. Where labor costs are different the economy of rebuilding will be influenced accordingly.

(b) Experience has shown that parts reconditioned with electrodes specified in this chart give about 50% more service than when electrodes of other types are used. High alloy hard-facing type electrode has proved to be especially desirable as a base deposit for hard-facing because it is inexpensive and at the same time it resists impact.

(c) Top rollers can be rebuilt successfully when worn not more than ⅛ to 3/16 in. If wear is greater they are likely to crack because cast iron, from which they are made, will not withstand the shrinkage stresses of a great deal of welding. Preheating is sometimes advisable to prevent cracking.

(d) Includes 120 ft. of mild steel filler bar stock, ⅝ by 1¼ in. for rebuilding the cleats.

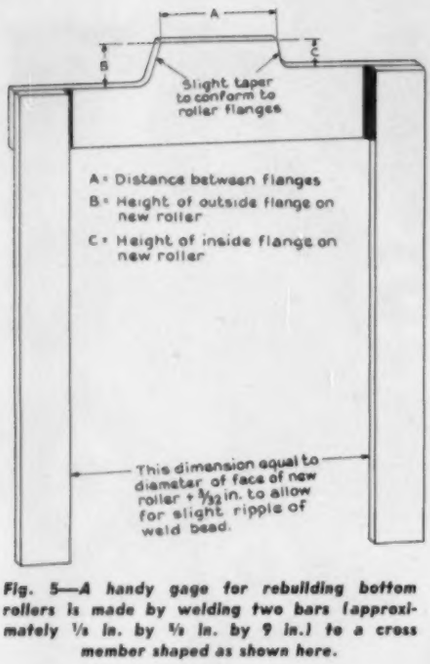

A
B
C
Slight taper to conform to roller flanges
A = Distance between flanges
B = Height of outside flange on new roller
C = Height of inside flange on new roller
This dimension equal to diameter of face of new roller + 1/32 in. to allow for slight ripple of weld bead.

Fig. 5—A handy gage for rebuilding bottom rollers is made by welding two bars (approximately ⅛ in. by ½ in. by 9 in.) to a cross member shaped as shown here.

as illustrated in Fig. 3. This extra reinforcement is necessary because of the extra wear along both outside edges of the sprocket.

All welding should be done in the down-hand or flat position, a procedure which can easily be followed by simply revolving the sprockets as welding progresses. In order to prevent overheating, no more than one pass is deposited on any one tooth before proceeding to the next. It is always deposited at the lowest part of the unfinished contour, starting from one side and welding across the entire width.

Since both sprockets revolve in unison, one pass is applied to each tooth in the entire upper half of one sprocket (in the lowest contour of each tooth) and the process repeated on the other sprocket before revolving the sprockets. To further reduce the amount of turning necessary to bring the teeth in welding position (also to reduce the number of passes needed) each pass can be made approximately ¾ in. wide by weaving. A fully rebuilt sprocket, removed from the tractor for photographic purposes, is illustrated in Fig. 4.

No grinding or other finish of the hard-facing deposit is needed because the tract which it engages is full floating and with contours fully restored the bushings have a rolling engagement rather than sliding. Rolling does not produce excessive wear on the bushings and the welded surfaces soon wear smooth, especially since sand and mud are thrown on the sprockets by the ever-moving track.

Experience shows that sprockets rebuilt in accordance with the above procedure soon take a bright surface polish. Because this surface is so much harder and more wear-resistant the sprockets not only last twice as long as new ones, but the track bushings also wear longer, since there is less tendency toward seizing or galling between the polished weld metal and the bushing as wear occurs.

Bottom Rollers

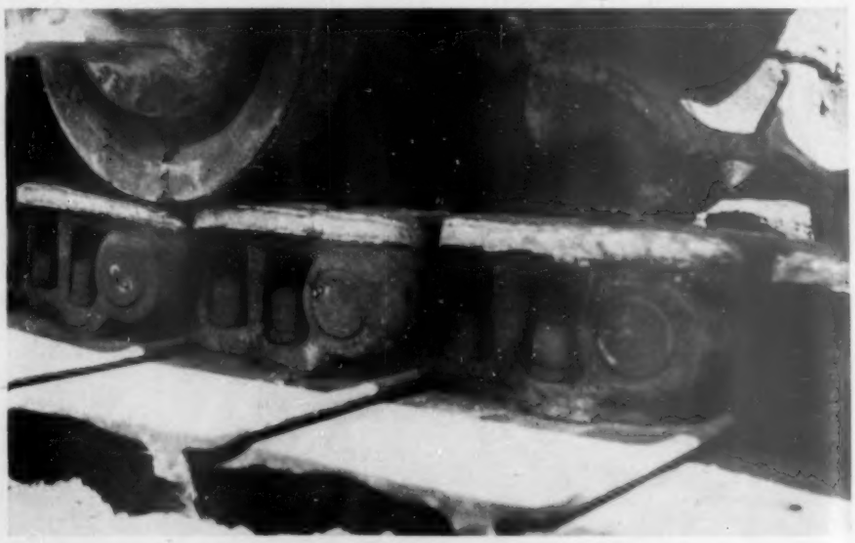
When bottom rollers become worn (Fig. 1, left) they can be restored to better than original usefulness (Fig. 1, right). Usually the actual welding is done after removing the rollers from the tractor. However, when flanges do not need rebuilding, welding may be accomplished by removing the entire arm which supports the lower rollers and placing it in an inverted position.

The particular type of wear to which bottom rollers are subjected requires the combined use of a hard-facing electrode for rebuilding the face and an alloy steel electrode for rebuilding the flanges. If the face is badly worn or dished out, two layers of hard-facing may be required, the first being applied to the badly worn or dished-out regions and the final layer woven across the entire face.

The flanges are built up to original dimensions with an alloy steel, since this type electrode produces a smooth finish and adds strength and stiffness to the flanges. In addition, it will not spall or flake when subjected to impact or flexing. Grinding or other finishing of the rebuilt roller is unnecessary regardless of whether or

Fig. 6 (above)—These track grouser cleats were hard-faced with ferrous alloy before excessive wear took place, thus avoiding the necessity of complete rebuilding.

Fig. 7 (below)—Properly rebuilt rails and rollers remove excessive lost motion and thus make for more effective tractor performance.



not the rails are to be reconditioned because normal service soon polishes wearing surfaces smooth.

To aid in judging the amount of deposit needed on both the face and flanges, a handy gage may be made as illustrated in Fig. 5.

Front Idlers

When front idlers become worn, they can also be rebuilt (Fig. 6). When only one layer of weld metal is required to restore the worn rims, it is applied entirely with a hard-facing electrode. The electrode used not only meets the requirements for wear on these idlers but it also meets the metallurgical requirements for welding to best advantage.

If two layers are required, however, the first is applied with an alloy electrode because of its resistance to mushing, spalling, or flaking. If the rims are worn down to such an extent that they are cracked or bent, the cracks are cut out and rebuilt with a mild steel electrode, after which resurfacing metal is applied.

An alloy electrode is also used on the flanges to produce a smooth finish. A slight taper is maintained on the flanges as they are built up to their original dimensions. In rebuilding each rim, the width is checked to be certain that the middle section is built up to symmetrical proportions. Grinding or other refinishing is unnecessary.

Track Rails

In rebuilding faces of track rails, much the same procedure is followed as in rebuilding idlers and rollers. If more than one layer is necessary, all but the last are welded with an alloy steel. The final layer is a hard-facing material put on either by weaving or in stringer beads. Care should be taken to rebuild the rails flat across the face to prevent dishing of the rollers.

In general, it is better to rebush the tracks (if needed) before hard-facing the rails. Otherwise, assembly after rebushing may be difficult due to the overlapping of hard-facing deposits between the links.

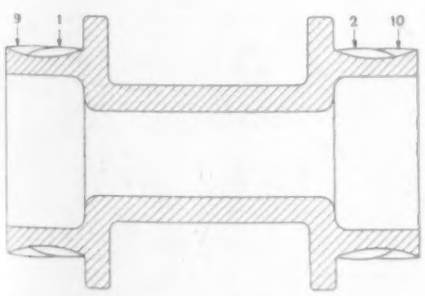


Fig. 8—Top rollers, when not worn more than 1/8 to 3/16 in., may be rebuilt successfully. Numbers indicate sequence of the four passes on the first double roller.

Fig. 9 (left)—Draw-bar clevis rebuilt with high alloy hard facing. Note use of washer around lower hole to reduce the amount of weld metal required. Fig. 10 (right)—Universal joint assembly of a carry-all grader rebuilt for further service with high alloy hard-facing.

If the track is worn narrow because of friction against the roller flanges, both the inside and outside edges may need a layer or two of deposit from an alloy electrode in order to restore their original width. It is important that the edges of the rails as well as the flanges of the idlers and rollers be rebuilt so that they have no more side play than new parts. Properly rebuilt and installed track rails are illustrated in Fig. 7.

Top Rollers

Top rollers are usually cast iron and it is not considered practical to rebuild them if they are worn down more than about $\frac{1}{8}$ to $\frac{3}{16}$ in. However, when wear is not too severe, welding is practical if the heat is kept low. This is accomplished, and at the same time excellent wearing qualities are obtained, by using a hard-facing electrode and applying only one bead to each roller face and then allowing it to cool.

In the meantime, it is common practice to apply a bead to another roller, and so on, to give each one a chance to cool before applying the subsequent bead. Each bead is applied with a weaving technique halfway across the face and all the way around, as indicated in Fig. 8. Also, the lowest heat which will obtain proper fusion is used for this work. A hard-facing material which flattens out smoothly and fuses well with the chilled cast iron of these rollers is required for this application.

Track Grousers

It is most practical to hard-face grouser cleats (Fig. 6) before they have had a chance to wear excessively. A second hard-facing application after the first has worn away will further prolong the useful life of cleats and eliminate the necessity of having to rebuild or replace them so soon.

In cases where cleats are worn down to within approximately one inch of the grouser plate, they may be rebuilt to prolong their useful service. For this purpose a mild steel bar having a cross-section of about $\frac{5}{8}$ in. in width and $1\frac{1}{4}$ in. in height is welded on top of each cleat, using a $\frac{3}{16}$ in. mild steel electrode.

The ends should be tapered toward the center at an angle of 30 deg. with the vertical in order to permit a strong job of welding to be done. The top edge of the rebuilt cleat should then be hard-faced.

Draw Bar Clevis

The wear experienced on the tractor draw bar clevis and universal hitch is met to best advantage by rebuilding with an alloy steel electrode. Since the draw bar clevis cannot be removed conveniently, metal must be deposited in the vertical position when rebuilding the holes in which the draw bar bolt fits. The $\frac{3}{16}$ in. diameter electrode is used for this work and is applied with a wide weave. It is also common practice to weld a washer over a hole, as shown in Fig. 9, to reduce the amount of weld metal required.

During welding the draw bar bolt should be inserted in the hole frequently and hammered from one side to the other to make sure it will fit into position when the weld has cooled. Other worn surfaces on which welding can be done in the flat position are rebuilt with an alloy electrode in the $\frac{1}{4}$ in. dia., as illustrated in Fig. 10.

Redesigning a Bar Stool

Arc welded construction cut costs 23% through saving in material and lessened production time.

By **ERNEST REISS**
General Manager
Art Chrome Co. of America

This arc welded stool has no bolts and nuts to work loose, and there is no danger of ladies tearing their stockings on rough surfaces.

NEW METAL furniture is now a thing of the past until the Jap-Nazis are firmly and forever licked. Nevertheless, this account of how a bar stool was redesigned to provide added strength at lower cost holds much of interest for readers of *The Welding Engineer.*

The stool is of the common type used commercially in drug stores and bars, and the problem was to change or redesign it so that it would stand up under both normal and abnormal abuse.

Bolted Construction

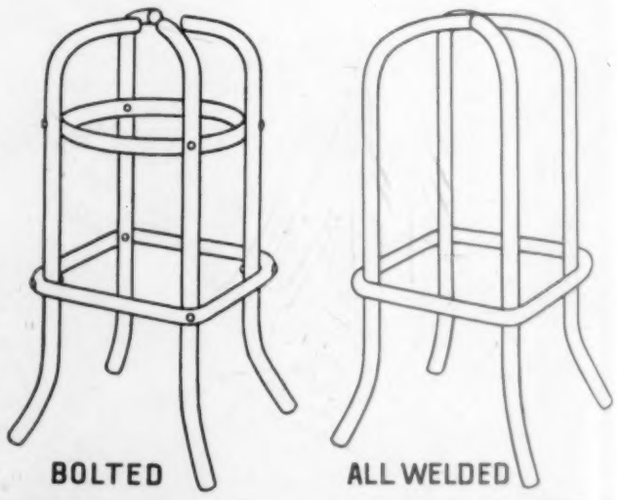
The original stool, shown at left of accompanying diagram, was made up of four pieces of 1 in. tubing bent to form legs. Another piece of tubing was bent to form a square and welded into one continuous piece. Finally, a piece of cold rolled steel, 2 in. by ⅛ in., was rolled into a circle and welded into a continuous piece. These parts were separately chrome-plated and then bolted together with eight ¼ in. R. H. machine screws, eight lock washers and eight cap nuts. But the bolts displayed a tendency to loosen under service, disintegrating the stool.

Changing to Welding

This stool was redesigned for all arc welded construction, as shown at the right of the diagram. First, the legs were bent, using three pieces instead of the original four, one long length of tubing being bent into a U-shape which formed two legs. The other two legs were now welded in place at right angles to the "U." The square piece was made as before. The flat ring, it was discovered after experimenting, could be eliminated entirely without sacrifice of strength.

After chrome-plating, the legs were placed in a jig and welded together at the top. Then the jig was turned over, and the square support welded outside the legs. Welding was done with a 3/32 in. mild steel electrode. By taking particular care, the burning of the chrome-plated surface was confined to a spread of not more than an inch. The welds were cleaned with steel wool and, to match the chrome finish, were painted with aluminum paint. When the stool was turned aright and the seat screwed on, no sign of welding was visible, since the square foot rest had been welded on its under side.

The arc welded stool is much stronger than requirements and will withstand any kind of hard use. In addition, a 23% savings on each stool resulted from elimination of the round ring and lessened production time.



Left: the original stool. The bottom square served as a foot rest, and the flat ring as an inside support. Right: the stool as redesigned. Note that flat ring has been eliminated and that there are only three leg pieces instead of four.

Drawing by Hobart Bros. Co.

BUY U. S. WAR BONDS AND STAMPS

Fig. 1—Applying a new end to a radius rod extension keeps this hard-to-machine part from the scrap heap.

Welding in the Railroad Shop

Few people realize the magnitude of some of the maintenance and repair jobs that are being performed every day by skilled railroad weldors. For heavy duty or light, the oxy-acetylene torch is about the most useful tool to be found anywhere in the railroad shop.

By
ARTHUR HAVENS

WELDED SHIPS, welded buildings, welded armament! From every corner of our great country we hear about welding, the greatest tool of fabrication and repair ever invented or developed. However, amid all the hue and cry about welding let us not forget about railroad welding. The effective use of gas welding for the past twenty years has saved railroads many thousands of dollars in labor and new parts.

Few people not directly connected with railroad welding realize the magnitude of some of the oxy-acetylene welding jobs that are accomplished by the many skilled railroad weldors. Most of these so called old timers of acetylene welding have at least 15 years experience and while most of them are sorta hard boiled and prone to spin a yarn about the days—WHEN—on the whole they are a pretty fine group of men.

The average job shop weldor would shy away at the thought of putting 250 lbs. of bronze into one job yet this is not uncommon in the railroad weldors' daily routine. Ofttimes it is necessary to remove huge portions of 1¼ in. and 2 in. thick cast iron outer cylinder walls to make accessible a cracked intake or exhaust port.

The size and shape of a cast iron locomotive cylinder is such as to demand a thorough preheat before any welding or brazing can be successfully undertaken. Several methods of preheating are employed and most of them are good. In the smaller shops where heavy cylinder welding is only occasional the weldors use a furnace. This furnace, constructed of fire brick, is arranged so that certain brick may be removed in those sections where brazing must be done. In the larger shops, where this work is commonplace, large steel boxes lined with block asbestos are made and placed over the cylinder to be repaired. These boxes are constructed so that it is a simple matter to remove a section of the box with the cutting torch to facilitate the work and after the brazing is completed this section is welded back into place. Charcoal is the fuel generally recommended, the type furnished in briquette form is the most convenient.

The skilled railroad weldor is usually more proud of his ability to weld the giant locomotive frame than he is willing to admit. There is a feeling of pride and accomplishment in the joining two pieces of a 6 in. by 9 in. steel locomotive frame with two oxy-acetylene torches and pounds of steel rod.

Twenty years ago a 4-in. square frame would require 12 to 14 hrs. welding time and from four to ten weldors to do the job. Now with the modern equipment and revised methods two experienced weldors will weld a 6-in. square frame in 2½ hours. This is a marked improvement in such a few short years!

Fig. 2—Building the threaded end of a piston valve stem back to normal.

All the work is not the so called heavy duty welding jobs. For example there is the radius rod extension. This rod, a round steel bar which slides in a brass brushing lined steel box, exposed to flying particles of abrasive material so the bottom of this radius rod wears considerably. They do wear so badly the rod must be turned 180 deg. and a new bushing made for the box. In two turnings the shaft is so weakened that the least added strain will bend where the shaft joins the fork. The first thought, when this condition developed, was to shrink a steel bushing on the newly turned shaft; this repair returned the shaft to its original size but did not replace the strength where it was needed. When the welding foreman was asked his opinion he suggested that the worn out end be cut from the fork and a new piece of steel of sufficient diameter to machine to the size be welded to the fork. Though questioned, it was attempted and has proved so successful that it is now a standard practice.

Production Welding

A year ago last Christmas eve a weldor was called and informed that the locomotive for the midnight run south from the Canadian border was down in an engine house some 100 miles from the main shop. The reason—a broken radius rod extension. This was at 3 p. m. The weldor arrived at the outlying point at 7:30 and found that machinist had fashioned a new end to replace the piece that had broken and been lost. The radius rod extension was removed from the engine then the new piece and the fork were scarfed, aligned, and welded. The repaired extension was on the locomotive while still red hot, the other parts were replaced and at 8:45 p. m. the massive Pacific type locomotive started on its way bringing the weldor home to a belated Christmas eve party. This engine showed no out of service simply because of the adaptability of oxy-acetylene welding and cutting and the ability of a veteran weldor.

It is not uncommon for a piston valve stem to become stripped and battered. The usual practice was to take these rods to the blacksmith shop where a foot or so of new material is added to the remaining, still usable valve rod. This method necessitated so much machine work that the railroad shop foreman asked the weldor if it were not possible to rebuild the stripped section with a grade of steel similar to the original metal. Naturally, the answer was in the affirmative; in fact, the weldor was able to apply a grade of metal so homogeneous that after it was turned the foreman could not detect that it was weld metal.

Fig. 3—Even steam hammer piston rods are repaired by welding.

New Steam Line

In every railroad shop there are many pipes conveying the gas, air, oil, steam and water to carry on the work in the shop. This piping, especially the steam line, usually requires a great deal of maintenance. But maintenance expense is held to a minimum where acetylene welding and cutting is employed to remove the leaky and worn out sections.

A high pressure steam line in a small railroad shop reached the point where it was repair most of the time. The boss weldor suggested a complete new line—all welded of course. The foreman agreed but it seemed impossible to shut down the steam long enough to install a complete new line. Nevertheless a couple of pipefitters and two weldors put in the entire 320 ft. 3-in. and 4-in. overhead piping including special fittings by shutting down the steam two Sundays. Fig. 4 clearly illustrates a group of prospective leaky flanges and the neat all-welded fittings made to take their place. This line was hung amid pulleys and shafting making it impossible to erect more than one length of pipe at a time. To simplify the welding the tie in welds were left till last thus freeing the pipe to turn in the hangers while making the major-

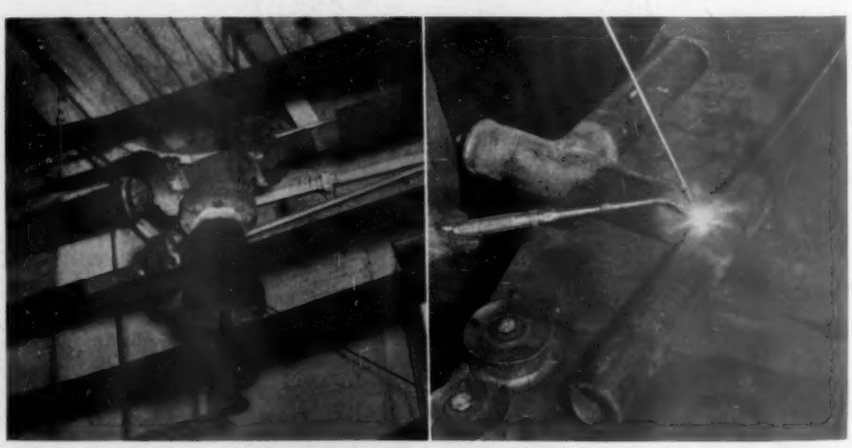


Fig. 4—A steam trap (left) with many flanges is replaced with a welded unit (right).

ity of the welds. All the work was accomplished from ladders without the aid of staging.

Rebuilding with Weld Metal

Without modern acetylene welding it would be extremely difficult to maintain the modern lead truck in A-1 condition. Many parts of the lead truck are so constructed that rebuilding with weld metal is the only repair possible. These parts are: namely, the swing links, main casting, frame and center casting. The cast steel swing links support the weight of the front of the locomotive in such a way to permit freedom of movement. Naturally, there is a great deal of wear on the top which supports the center casting and the four half round points which fit into the semicircular pockets in the main casting. It is not unusual to find, upon dismantling the truck, that the 1-in. radius of the swing link bottom rockers is reduced by ½-in. or ⅜-in. The top bearing having a much larger wearing area does not wear so rapidly, however, it usually needs rebuilding. The four bottom positions are centered when made; these centers greatly assist the weldor for with a simply constructed gage he can check the radius of the parts as he applies the weld metal. The front end, the part near the center, is rebuilt, peened and checked with the gage until perfect. As the rebuilding and peening progresses the balance of the bearing is carefully checked with a small steel square keeping the lug square with the portion previously made with the gage. A mild steel rod is used for this application and with a torch fitted with an 80 cu. ft. size tip.

The top or the large bearing area is rebuilt with the torch applying enough weld metal so that this surface may be machined. This is quicker and the resulting surface is naturally superior to one obtained by peening.

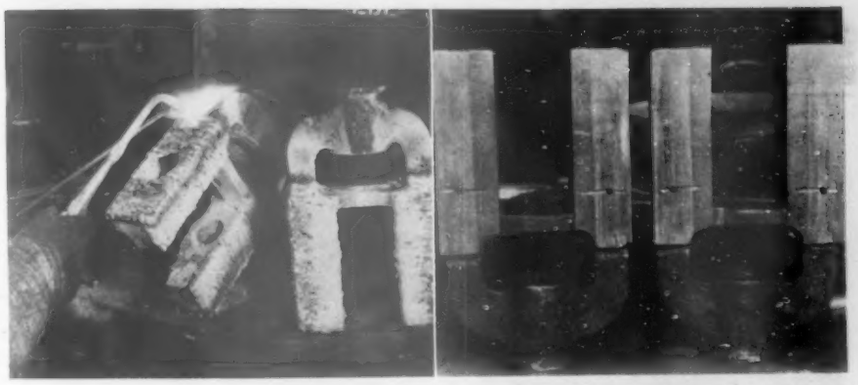


Fig. 6—Brazing is the most effective means of replacing worn babbitt on valve cross heads (left). Bronze surfaces (right) show little wear between general overhauls.

Truck Frame Repaired

The truck frame itself is often found to be broken. This can be cut out with the cutting torch, allowances being made for contraction of the weld. The break is then welded with a mild steel welding rod and an acetylene flame. Eight half round pockets in the main casting are also rebuilt and hammered to conform with a templet made for this purpose.

One might think that this would wind up the welding on the lead truck but this is not true; truck jaws are invariably worn so bad laterally that they also must be rebuilt or renewed. In most cases the jaws are cast iron so a wear resisting bronze is applied. The truck is turned up on its side when the jaws are left on the truck for welding. The weldor applies the bronze as carefully as possible so that the surface may be finished with a portable grinder.

From the foregoing it is obvious that almost every part of the lead truck comes in for its share of welding and when the locomotive goes back into service the lead truck is in an as new condition.

Occasionally it is discovered that parts designed for a certain type of metal function more economically and more satisfactorily when this metal is applied with the torch. This is especially true of the locomotive driving box and the valve crosshead bearings. The driving box designed for a poured bronze hub liner have been known to give trouble due to excessive wear as well as liner breakage with pieces falling from the box. This disagreeable and hazardous condition was entirely eliminated by brazing in which wear resisting bronze was applied to the driving box hub surface by the acetylene process.

Braze Valve Crosshead

The case of the valve crosshead differs somewhat, in this instance babbitt metal is replaced with wear resisting bronze. The valve crosshead, like the driving box, need constant attention and often have to be removed after a few weeks of service. In Fig. 6 there is shown a pair of valve crossheads after having been in use from general repair to another. The wear on these crossheads is less than $\frac{1}{16}$".

Although weldors are prone to crow about the adaptability of oxyacetylene welding to heavy work small jobs are equally important. Often the weldor with torch and rod can create small articles that are hard to buy, sometimes unobtainable.

Design New Hook

Recently a electrical maintenance man wanted some peculiar shaped links with a hook attached for use on a semaphore tower. Stores and supply houses were searched but nowhere could the article wanted be found. Turning, as usual, to the weldor an outline was given of the needs and soon the weldor created a link and hook that suited the purpose

Fig. 5 — Rebuilding and hammering the half round lugs on the lead truck swing link. Note wear on end not yet welded.

Fig. 7 — The welding torch lends itself readily to the fabrication of many small parts such as the pictured oil cup.

admirably. In another instance a simple and low priced oil cup was needed for the link motion and trailer boxes. The stores department had nothing suitable so once again the weldor was asked to make something. It was done by rolling 20 ga. black iron into a cone 1½-in. in dia. at the top with the bottom made to fit the O. D. of a ¼-in. pipe nipple. The nipple was welded to the cone the seam in the cone welded; two pieces of ⅛-in. welding rod were tacked across the top to hold in the curled hair. The cone was filled with curled hair to provide a finished oil cup. Since then hundreds of home made oil cups have been fabricated and now adorn every locomotive on the railroad.

A great many years ago a New England railroad with a small repair shop abolished the welding of superheater flue safe ends because of several failures. Acetylene welding however replaced previous methods and immediately it was brought home to the boiler foreman that he had been wasting both time and money for the acetylene welded safe end was accomplished quicker, neater and from that day, 16 years ago, there has yet to be a superheater flue to fail in a weld.

It is obvious from the foregoing that oxy-acetylene welding still plays an important part in the maintenance of locomotives and it is not hard to realize the chaotic condition that would ensue should all the oxy-acetylene cutting and welding equipment be removed from the railroad shop.

Welding and Skin Troubles

By **WALDEMAR SCHWEISHEIMER, M.D.**

CERTAIN METALS used in welding may volatilize and condense on the skin, giving rise to skin diseases. This is not usual, however. Foreign medical literature makes more mention of such cases than does the American, and those mentioned are not well founded in many instances.

In sensitive persons, radiation from the arc may enhance the skin sensitivity. This radiation is a mixture of ultra-violet light, infra-red rays and visible light. Exposed parts of the body should be well protected against it, not only the eyes but also the skin.

Dermatitis (inflammation of the skin) due to the wearing of various protective equipment such as leather gauntlets or rubber gloves has been described. This, however, is a hypersensitivity to a particular article or articles of clothing rather than to any part of the welding process.

As is well known today, certain skin troubles occur when a worker is allergic or sensitive to certain substances. Some weldors and other metal workers are sensitive to chrome, nickel or zinc, etc. Even very small particles of the particular material may irritate the sensitive skin. If the skin is transpiring (perspiring), the tendency to be irritated is greater.

The "Patch Test" is used frequently in industrial plants to determine whether or not a worker is particularly sensitive to any certain metal or other material. A small amount of the suspected substance, or an extract of it absorbed in a piece of blotting paper or lint, is applied to a healthy part of the skin and held in place with adhesive plaster.

If the worker is actually sensitive to the material, a reaction similar to the original skin irritation will be produced. The reaction may be either immediate or delayed. Immediate reaction develops within five or ten minutes after application and assumes the form of a wheal (raising such as is caused by mosquito bite), which may be itchy or burning. The delayed reaction, occurring after some hours or even as late as two days after the beginning of the test, may assume the form of wheals or develop other symptoms of skin irritation such as reddening (erythema), swelling, itching, a burning sensation or a general eruption accompanied by intense itching.

Should it be desirable to know the exact ingredient within an alloy responsible for a skin irritation, a patch test must be carried out with every single constituent, for any one might turn out to be the irritating substance. Consequently, it sometimes takes no little time and patience to discover the real cause of a skin trouble.

Improvement and perfect healing are accomplished in most cases as soon as the injurious substances are removed from contact with the skin. Sometimes, however, a special treatment of the skin trouble may be necessary. It is important not to neglect any small sores or skin injuries—many a long standing skin disease could have been prevented by early treatment of those small beginnings.

Cleanliness is also important in the prevention of industrial skin irritations. The workers must be given adequate washing facilities—warm water, a mild soap, perhaps a little soda if necessary. The soap should not be unduly alkaline as this tends to soften the horny layers of the skin.

Fig. 1—Steelwork from the South Gate of the New York World's Fair as re-erected by Lucky Teter at the entrance to his Langhorne speedway. This view shows the entrance to the basement garage, below the highway level.

Tubular Structures Portable

By H. S. CARD

Director, Product Development, Formed Steel Tube Institute

"Lucky" Teter, champion dare-devil of the Hell Drivers, demonstrated that even 76 ft. trusses can be cut loose with flame torches, transported in flat cars and re-welded into place at another site.

WHEN THE TIME came to dismantle the recent New York World's Fair, the entire South Gate structure was purchased by E. M. ("Lucky") Teter, the ace dare-devil whom you've probably seen in the movie newsreels, for his Langhorne speedway on U. S. Highway No. 1 at Langhorne, Pa.

Major Moving Job

Moving this huge structure from its World's Fair site to Langhorne presented a major problem: the transportation of seven 76 ft. trusses whole. Flat cars large enough to handle such trusses were finally made available, and, by making some special arrangements with the railroads, the shipment was successfully completed.

The trusses were cut from the columns with flame cutting torches. The same columns were then erected on a new foundation at the entrance to the speedway, and the trusses were rewelded into place as shown in Fig. 1. The location of the welded joints on the front and rear columns may be seen in Figs. 2 and 3.

The tubular framework of the South Gate probably received the least attention of the many distinctive designs developed by the World's Fair architectural staff, yet it had artistic styling and engineering features which are rarely found in conventional steel structures. All of the ugliness of beams, angles, gusset plates and rivet heads was eliminated from this gate structure by welding smooth tubular sections for columns and for chord and web members of trusses. Furthermore, the tubular structure had far greater load capacity than could have been obtained by using rolled shapes of the same weight.

Truss Construction

As originally constructed, the tubular column members were integral with all the seven 76 ft. trusses. Connecting the columns across each bay at front and rear were Warren trusses, almost made of tubular members. Fig. 2 shows how these trusses were assembled with the same simple joint design used in the main trusses. It is obvious that the entire steel framework was welded together into a single piece of steel. The fact that each member has the

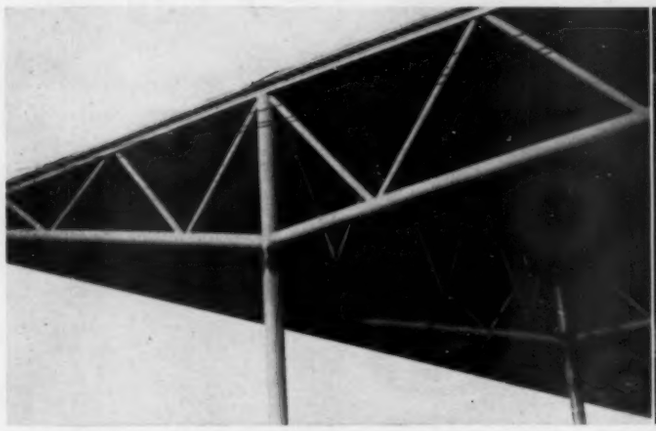


Fig. 2—View of front end of one of the main trusses. Design of the lateral bracing truss can also be seen in this picture. Note the welded joint where the truss was re-joined to its supporting column.

Fig. 3—Rear end of main truss, showing welded connection to the rear column. The fact that the column was integral with the truss as originally constructed greatly simplified dismantling and re-assembling.

same radius of gyration in all directions assures maximum rigidity for the amount of steel used.

A noteworthy feature of the design of the main trusses is the tapered shape, which distributes the material very efficiently. Another feature is the simplicity of the connections of web members to chords, etc. Such details mark the structure as having been carefully engineered.

Supporting columns are 5⅝ in. outside diameter by 0.28 in. thick wall. Front columns are 22 ft. from front end of truss, and rear columns are set in 4 ft. from the rear. Top chords of the trusses are H-beams. Lower chords are 5½ in. OD by 0.26 in. Web members are 2⅞ in. OD by 0.20 in. The center panel of the truss tapers from 52 in. depth at the front column to 21 in. at the rear column. The Warren trusses used for lateral bracing of the roof structure are 18 ft. long and 52 in. deep. Chords of these trusses are 2⅜ in. OD by 0.15 in., and web members are 1⅞ in. OD by 0.14 in.

Hell Drivers' Headquarters

Lucky Teter is the star and originator of the automobile and motorcycle stunting "Hell Drivers." He purchased Langhorne Speedway to provide headquarters for the Hell Drivers and to stage big league auto races. Here he keeps $250,000 worth of automobiles and trucks. During the auto race season the building will provide facilities for race car owners to put their high priced racing cars into shape.

This noteworthy construction "stunt" of Teter's seems to furnish a conclusive answer to all questions regarding the difficulty of dismantling and reassembling welded tubular structures. Apparently, it is not necessary to design and manufacture costly mechanical fittings in order to achieve portability. Welding and cutting do the job better, cheaper and quicker as Lucky Teter has shown.

New Ring at One-Third Cost

By **L. H. PARKER**
Engineer, Turlock Irrigation District

A PROBLEM confronting the Turlock (Calif.) Irrigation District was the replacing of the seal ring of a hydro-electric turbine. This ring, an alloy steel band, is 5 ft. in dia., ½ in. thick by 2 in. wide. To insure an accurate shrink fit, the ID is machined to a pin gage dia. of about minus 0.062 in.

Ordinarily turbine seal rings are shrunk on to the turbine wheel, just like an iron tire on a wagon wheel. Machining the inside surface of this steel band is slow and difficult. It takes time — and costs considerable money—to set up a 5 ft. band on the boring mill and clamp it at sufficient places to keep it rigid while turning. To say nothing of the turning job itself!

Instead of installing a whole new seal ring, it was decided to replace the worn metal with new metal by welding. In effect, this was making a new band out of the old. It saved: (1) the labor of removing the old ring, (2) machining of the inside face of the ring and (3) labor of shrinking a new ring in place.

A cost comparison of the two methods is as follows:

New Ring and Machining

15½ ft.—1 in. by 2 in. steel bar	$ 4.50
Labor and machining	56.25
TOTAL	$60.75

Arc Welded Seal Ring

Electrodes	$ 2.50
Welding and overhead	18.00
TOTAL	$20.50

The welded ring fits perfectly and is much tighter than the old one due to the natural weld metal contraction.

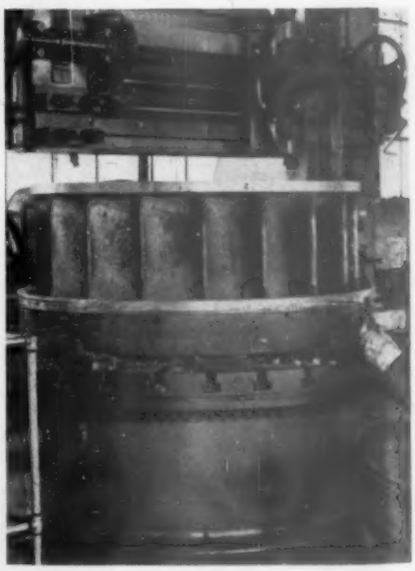


Photo by Hobart Brothers Co.

Expense of installing a new turbine seal ring was cut 60% when plant engineers decided to deposit a ring of weld metal on top of the base of the old band without removing it.

Limitation Order L-146

A new priority regulation which places strict control on welding rod and electrode distribution is interpreted. A new Priorities Regulation, No. 12, and amended regulations 1 and 3 are discussed.

On June 13, 1942, the distribution of welding rods and electrodes was placed under strict control by the Division of Industry Operations of the War Production Board.

Under the terms of Limitation Order L-146—this order is published in its entirety in this article—welding rods and electrodes may be delivered without restrictions only to the Army and Navy, specified Government agencies, governments of the United Nations, for operations under the Lend-Lease program, and to accredited schools which are training welding operators under a course conforming to the American Welding Society's code for minimum instruction requirements, or schools established within industrial plants which meet certain instruction qualifications.

Other deliveries of ordinary rods and electrodes are confined to orders bearing a preference rating of A-9 or higher. In the case of alloy electrodes or rods, which mean ferrous-base electrodes or rods whose core wire contains more than 2 per cent by weight of materials other than iron or carbon, deliveries may not be made except on orders of A-1-J or higher.

Accredited schools are prohibited from using alloy rods or electrodes except in qualifying tests. They are also prohibited from furnishing to any apprentice more than one pound of rods or electrodes per hour of instruction. They must certify to the person making delivery of this equipment that they are accredited schools, or that they are organized within an industrial plant and furnish a course intended to qualify an apprentice as an industrial welder in 200 hours or less of instruction.

The order also provides for the setting aside each month, for repair and maintenance purposes only, 6 per cent of each type of rod or electrode delivered by a manufacturer during that month. Persons ordering rods and electrodes for repair and maintenance must so specify on their orders and must not use the equipment for any other purpose.

No one is permitted to acquire rods or electrodes if the result will be to increase his inventory beyond a sixty-day supply. Manufacturers must file a record of all shipments with WPB on Form PD-528 on or before the 18th day of each month. The order follows:

Title 32—National Defense
Chapter IX—War Production Board
Subchapter B—DIVISION OF INDUSTRY OPERATIONS
Part 1271—Welding Rods and Electrodes
General Limitation Order L-146

The fulfillment of requirements for the defense of the United States has created a shortage in the supply of Welding Rods and Electrodes for defense, for private account and for export; and the following order is deemed necessary and appropriate in the public interest and to promote the national defense:

Section 1271.1 General Limitation Order L-146

(a) **Definitions.** For the purpose of this order:

(1) "Person" means any individual, partnership, association, business trust, corporation, governmental corporation or agency, or any organized group of persons, whether incorporated or not.

(2) "Electrodes" mean either bare or flux coated filler metal in the form of either cut lengths or coils and designed to be deposited by the electric arc welding process.

(3) "Rods" mean either bare or flux coated filler metal in the form of either cut lengths or coils and designed to be deposited by a gas welding process.

(4) "Alloy Electrodes or Rods" mean ferrous base Rods or Electrodes whose core wire contains more than 2%, by weight, of materials other than iron or carbon.

(5) "Manufacturer" means any Person producing Electrodes or Rods.

(6) "Distributor" means any Person in the business of distributing Electrodes or Rods, except a Manufacturer.

(7) "Accredited School" means any instruction unit which (i) offers a course of training for welding operators which conforms to the American Welding Society's "Proposed Code of Minimum Requirements for Instruction of Welding Operators" as issued at the date of this order, or is organized within an industrial plant; and (ii) furnishes to the apprentice a full training course devoted entirely to one welding process, which qualifies the apprentice as an industrial welder in not to exceed 200 hours of instruction.

(b) **Restrictions on Delivery of Rods and Electrodes.** No Manufacturer or Distributor shall deliver any Rods or Electrodes, and no Person shall accept delivery of any Rods or Electrodes except as follows:

(1) To fill any order for Rods or Electrodes to be delivered to, or for the account of:

(i) The Army or Navy of the United States, the United States Maritime Commission, the Panama Canal, the Coast and Geodetic Survey, the Coast Guard, the Civil Aeronautics Authority, the National Advisory Committee for Aeronautics, the Office of Scientific Research and Development;

(ii) The Government of any of the following countries: Belgium, China, Czechoslovakia, Free France, Greece, Iceland, Netherlands, Norway, Poland, Russia, Turkey, United Kingdom including its Dominions, Crown Colonies and Protectorates, or Yugoslavia.

(2) To fill any order placed by any agency of the United States Government for Rods or Electrodes to be delivered to, or for the account of, the government of any country listed above, or any other country, including those in the Western Hemisphere, pursuant to the Act of March 11, 1941, entitled "An Act to Promote the Defense of the United States" (Lend-Lease Act).

(3) To fill any order, other than an order for Alloy Electrodes or Rods, or an order for maintenance and repair, to which the Director of Industry Operations has assigned a preference rating of A-9 or higher.

(4) To fill any order for Alloy Electrodes or Rods, other than an order for purposes of maintenance or repair, to which the Director of Industry Operations has assigned a preference rating of A-1-j or higher.

(5) To fill any order for maintenance and repair purposes within the quantity limitations specified in paragraph (c) hereof.

(6) Subject to the provisions of Paragraph (e), to fill any order placed by an Accredited School.

(c) **Deliveries for Maintenance and Repair Purposes.** No manufacturer shall, during the period from the effective date of this order to the end of the current month or during any calendar month thereafter, deliver Rods or Electrodes, of any single kind or type listed in Form PD-528, for maintenance and repair purposes in quantities in excess of 6%, by weight, of deliveries of such kind or type by such Manufacturer in such period or month. Persons placing purchase orders for Rods or Electrodes to be used for maintenance and repair purposes shall identify such orders by marking on the purchase order "For Maintenance and Repair—....Pounds." No Person shall use or resell Rods or Electrodes so ordered for any purpose other than maintenance and repair and no Person shall use or resell for maintenance or repair purposes, Rods or Electrodes ordered for purposes other than maintenance or repair.

(d) **Restrictions on Inventory.** No Person shall acquire Rods or Electrodes if such acquisition will increase his supply of such Rods and Electrodes to more than a sixty day supply.

(e) **Deliveries to Accredited Schools: Restrictions on Accredited Schools.** No school, other than an Accredited School, shall accept delivery of any Rods or Electrodes. No Accredited School shall furnish to any apprentice more than one pound of Rods or Electrodes per hour of instruction. No Accredited School shall use Alloy Rods and Electrodes except in qualifying tests. Each Accredited School receiving delivery of Rods and Electrodes shall certify to the Person from whom it receives such delivery, as a condition to receiving such delivery, the following on the purchase order, or in a separate letter:

"The undersigned hereby certifies that it is an Accredited School, as defined in paragraph (a) (7) of General Limitation Order L-146, and that Rods or Electrodes to be received will be used by an instruction unit which

cross out inapplicable one

1. offers a course of training for welding operators which conforms to the American Welding Society's "Proposed Code of Minimum Requirements for Instruction of Welding Operators" as issued at the date of said order.
2. is organized within an industrial plant, and furnishes an apprentice a full training course devoted entirely to one welding process, which qualifies the apprentice as an industrial welder in not to exceed 200 hours of instruction.

_____ School

By _____

No Person shall make delivery under paragraph (b) (6) who has reason to believe that the Person accepting delivery has furnished a false certification; and no Person shall falsely furnish the certification specified above. The certification specified above shall constitute a representation to the Director of Industry Operations of the facts certified therein.

(f) **Applicability of Priorities Regulation No. 1.** This order and all transactions affected thereby are subject to the provisions of Priorities Regulation No. 1 (Part 944), as amended from time to time, except to the extent that any provision hereof may be inconsistent therewith, in which case the provisions of this order shall govern.

(g) **Existing Contracts.** Fulfillment of contracts in violation of this order is prohibited regardless of whether such contracts are entered into before or after the effective date of this order. No Person shall be held liable for damages or penalties for default under any contract or order which shall result directly or indirectly from his compliance with the terms of this order.

(h) **Appeals.** Any Person affected by this order who considers that compliance therewith would work an exceptional and unreasonable hardship upon him may appeal to the War Production Board setting forth the pertinent facts and the reason he considers he is entitled to relief. The Director of Industry Operations may thereupon take such action as he deems appropriate.

(i) **Communications to War Production Board.** All reports required to be filed hereunder, and all communications concerning this order shall, unless otherwise directed, be addressed to:

"War Production Board
Washington, D. C. Ref: L-146"

(j) **Records.** All Manufacturers and Distributors affected by this order shall keep and preserve for not less than two years accurate and complete records concerning production, deliveries, and orders for Welding Rods and Electrodes.

(k) **Reports.** On or before July 18, 1942, for the month of June, and on or before the 18th day of each month thereafter, for the preceding month, each Manufacturer shall file a record of shipments on Form PD-528.

(l) **Violations.** Any Person who wilfully violates any provision of this order, or who wilfully furnishes false information to the Director of Industry Operations in connection with this order is guilty of a crime and upon conviction may be punished by fine or imprisonment. In addition, any such Person may be prohibited from making or obtaining further deliveries of, or from processing or using material under priority control and may be deprived of priorities assistance by the Director of Industry Operations.

(m) **Effective Date.** This order is to become effective seven days from the date of issuance.

Issued this 6th day of June, 1942.

J. S. Knowlson
Director of Industry Operations

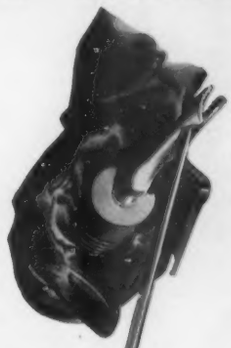
Limitation Effects

The effects of this limitation order will be far reaching; as a result the purchasing habits of many consumers of welding rod and electrodes will be changed. Those primarily affected will be the job shops which have resorted to General Repair Order P-100 and its A-10 rating for their priority needs. Another group will be the welding schools which have been obtaining supplies on Preference Order rating P-92. They now must meet definite teaching standards before they will be able to secure additional material.

Most job shop operators and users of welding will find their problems no worse than they have been under conditions existing prior to L-146. In recent months an A-10 rating has been found to be of little value when it came to getting supplies. Just as these difficulties were forever present in the past, they remain; to overcome this inability to obtain material the remedy has been one of obtaining a better priority rating than the one which would not produce the goods. The only way to obtain weld

MAKE HEAVY FLAT WELDS LIKE THESE

FASTER



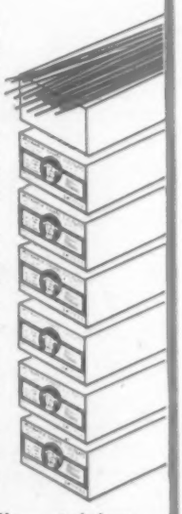
with Flexarc

DH

(DOWNHAND)

electrodes

Match the Electrode to the Job...!



FLEXARC FP—Use FP with a-c or d-c for fillet position and general-purpose, high-speed welding on low and medium carbon steels.

FLEXARC AP—For all position welding on low-to-medium carbon steels with minimum spatter. Reverse polarity d-c.

FLEXARC SW—Use SW for thin sheet metal welding. A general-purpose, all position electrode. A-c or d-c.

CASTINGWELD AND FREE-MACHINEWELD—For welding iron castings. Latter type made especially for work to be machined.

HARDENTOUGH—Four grades to meet all requirements of hard-surfacing machinery parts.

NICKELCHROM—For welding stainless steels.

NICKELMANG—For manganese steel welding.

THEY'RE MADE ESPECIALLY FOR HIGH CURRENT DOWNHAND WORK... BUTT AND FILLET WELDS

When you clamp DH in the jaws of the holder, you can really step up the speed of deep groove multiple pass welds on low and medium carbon steels without danger of undercut. Wherever large diameter electrodes and high currents are used for downhand work, DH "hot" rods will give uniform penetration, proper fusion and flat contours. The finished bead with DH is particularly smooth.

From the first pass to the finished bead, you'll have minimum spatter—even when currents are abnormally high. As a result, cleaning time and electrode loss are kept down. And welds which meet the most rigid code requirements are completed faster.

DH electrodes work equally well on both a-c and d-c. Available in diameters from $\frac{3}{32}$" to $\frac{3}{8}$". Try DH and be convinced. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

J-21193

Westinghouse

FLEXARC ELECTRODES

ing electrodes and rods under L-146 is to submit an application for priority rating form and try for an A-9 or higher—the higher the better if you want materials for use in the near future.

School Restrictions

One important change in the welding industry will result from limitation order L-146. In this instance, the change will be welcomed, for it will definitely improve the teaching standards of many welding schools. THE WELDING ENGINEER has long advocated that welding schools be supervised so that the gyp welding school might be eliminated from industry. Order L-146 should prove an effective step in this direction!

This limitation order specifies that only schools meeting the requirements of the American Welding Society "Code of Minimum Requirements for Instruction of Welding Operators" will be permitted to obtain welding rods and electrodes.

Such a provision will have far reaching effects, as this code sets up definite requirements regarding equipment and facilities of schools, instructors' qualifications, instruction methods and testing of student welders. Among the important points specified by this Code, which are overlooked too frequently by many welding schools, are: Number of hours of instruction, number of students to an instructor, welding equipment required, instructors' experience, welding exercises and testing procedure. It is most unfortunate that it is necessary for a nation to become involved in war to obtain regulation and ultimate elimination of the gyp welding school, but if L-146 does this it will be one of the few things good coming out of World War II.

New Preference Ratings

On June 27, the Director of Industry Operations issued Priorities Regulation No. 12 and amendments to Priorities Regulations 1 and 3 providing a means for rerating war orders. By these regulations provisions are made for applying a new series of high preference ratings. The new ratings are AAA, AA-1, AA-2, etc., all of which will take preference over ratings listed in the April issue of THE WELDING ENGINEER. Heretofore the highest rating has been AA, whose use was permitted only by special authorization of the Director of Industry Operations. This rating is now abolished, and all outstanding AA ratings are automatically changed to AA-2.

The chief purpose of the rerating is to permit greater flexibility in the assignment of preference ratings to definite quantities of military and related non-military items, most of which have recently been either AA or in the A-1 series. It will permit use of the top ratings for a balanced program of urgent war materials without seriously disturbing the pattern of ratings for other war and essential civilian orders.

The new high ratings may be assigned either directly by the Director of Industry Operations or by appropriate officers of government war agencies expressly authorized to issue reratings. A special form, PD-4X, called a "Rerating Direction," is prescribed for use where the Army, Navy or other government war agency rerates deliveries of war materials to be made directly to it. Whenever a Rerating Direction is issued, it must include the Allocation Classification and Purchasers' Symbols required by Priorities Regulation No. 10.

Manufacturer's Rerating

A separate form called a "Rerating Certificate," PD-4Y, is provided for use by a manufacturer whose deliveries to a war agency have been rerated, so that he may in turn rerate related deliveries to be made to him. The test for determining what deliveries may thus be rerated by a manufacturer or his suppliers is substantially the same as the test for determining to what deliveries an original rating may be applied or extended, as specified in Priorities Regulation No. 3, which was recently amended to provide a uniform standard in this respect.

A manufacturer may apply or extend the rerating to material which will be delivered by him on a rerated order, or physically incorporated in material so delivered, or to restore inventories to a practicable working minimum when material has been taken from inventory to fill a rerated order.

The new ratings may also be used by small companies for certain operating supplies which will be consumed in filling the rated order, up to ten per cent of the cost of materials to be processed, provided that not more than 25 per cent of such operating supplies are metals in the forms listed in Priorities Regulation No. 11. Such reratings may not be used to obtain operating supplies by any company whose use of the metals listed in Regulation 11 amounts to more than $5,000 in a quarter. Most such companies obtain ratings for their operating supplies under the Production Requirements Plan.

Companies operating under the Production Requirements Plan are specifically authorized, like other companies, to apply or extend the higher ratings to rerate deliveries to themselves, but may not use the ratings to obtain greater quantities of material than they are authorized to receive on their PRP Certificate (Form PD-25A) or a supplementary certificate issued upon application on Form PD-25F or PD-25H.

Rated Orders Displaced

Priorities Regulation No. 1 has been amended by altering the provision with respect to displacement of rated orders by new orders bearing a higher rating. Previously, no producer was required to direct material already processed to fill an order rated A-10 or higher which was within fifteen days of completion, even when he received a new order with a higher rating, unless the new rating was AA. Hereafter, this provision applies only in case the rating on the original order was higher than A-2. Such an order within fifteen days of completion must be displaced only by a new order with an AAA rating, or by specific direction from the Director of Industry Operations.

In no case, however, is a company required to terminate existing production schedules in less than fifteen days after receipt of a new rated order, and a company may continue on its existing production schedule up to a maximum of 40 days if change is impracticable, unless specifically instructed to change the schedule by the Director of Industry Operations.

Items Rated Separately

Priorities Regulation No. 3 is amended to conform to the provisions of Regulation 12, and the amendments to Regulation 1. The amendment to Regulation 3 also modifies the previous provision with respect to simultaneous extension of several different ratings. Whereas previously a company having several different ratings to be extended to orders for the same material could put them all together and write one purchase order for the entire quantity, using the lowest rating for all of it, this will now be permitted only when it is not commercially practicable to rate and obtain the items separately.

Ransome Announces . . .

a NEW 20 TON capacity Welding Positioner

DESIGNED to handle loads up to 22½ tons with a center of gravity 12 inches from the table top, this new Ransome Positioner offers a means to position-weld large heavy shapes and forms.

- ✓ 84 Inch Square Table tilts from 45° in one direction to a vertical position in the other.
- ✓ Provided with T-slots for readily attaching work to table top.
- ✓ Rotates a full 360° in either direction—controlled through remote push-button station.
- ✓ Tilts and turns simultaneously. Double tilting gear segments for uniform distribution of load.
- ✓ Base frame is of massive steel all-welded construction.

Performance records of Ransome Positioners indicate welding time savings up to 50% . . . rod saving up to 7%. Crane-waiting time is another consideration especially when handling large cumbersome pieces.

Write for complete information.

INDUSTRIAL DIVISION

RANSOME CONCRETE MACHINERY CO.

Dunellen, New Jersey

Brief Sketches of Welding Jobs

Fireproof Building

By Warren H. Martin

Five fires, with losses totaling over $68,000, has been the unlucky plight of C. H. Riffle, owner of a huge super service station and garage in the heart of the Mojave Desert in California. To quench his fire losses, Riffle built the

Photo Hobart Bros. Co.

Framework of all-welded gasoline station in the Mojave Desert where fire departments are few and far between. Cost of this welded pipe building was actually $2,500 less than the cost of the previous wooden frame building. Note welded tubular ladder at left.

50 x 50 foot all welded gas station—shown above under construction.

Over a mile and a half of used pipe was used in the framework for this station. First, the entire side frame of 2½-in. pipe was laid out and welded in sections on the ground. Bottom ends of the wall frame were fillet welded with $\frac{5}{16}$" mild steel rod and bolted to the concrete foundation. As each section was raised, it was butt welded to the previous one with $\frac{3}{32}$" rod. Cross braces, made from 1½-in. pipe, were welded in a similar manner.

Roof trusses, made from 1½-in. pipe also, were fabricated on the building site. Extreme care was taken to make tight and snug fittings throughout the framework. Framework was covered with sheet iron and painted. Total cost of previous wooden frame building was $7000. Cost of welded pipe building was $4500. Entire framework was constructed by Warren H. Martin, job welder, of Red Mountain, California.

» «

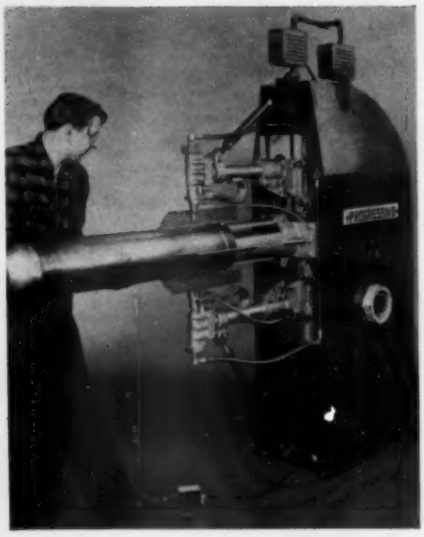


Photo by Progressive Welder Co.

Resistance welder used for spot welding fins on the housings of Army parachutes flares. The locating fixture for keeping the fins correctly aligned was removed before this picture was taken in order to show the electrodes.

"Stitching" Parachute Flares

Housings for the U. S. Army's giant parachute flares now have their fins "stitched" on by rows of spot welds, as shown in the accompanying picture. The machine is a pedestal resistance welder equipped with two movable electrodes, an upper and a lower, instead of the usual single one. The center electrode is fixed and serves as a mandrel for guiding the housing.

After completing a weld, the operator pushes the housing along, and the machine will repeat the welding operation automatically as long as the foot switch is depressed. Since both guns weld simultaneously, only one timer is required. To make sure that one movable electrode does not weld without the other, the machine is equipped with two pressure interlocking pressure switches.

About 18 welds are required for each pair of fins welded simultaneously, a total of 36 welds per housing. The same machine also spot welds the end ring to the main housing.

Three Brazes Simultaneously

The problem of brazing a ¾ in. threaded flange into a completely closed 20 ga. sheet steel container was solved by induction heating. Inductors, energized from a Model 1070 Thermonic Induction Generator, were placed directly over the flange and caused heating of the flange and a small area of the sheet steel container. A pre-placed ring of silver alloy melted and flowed to form a perfect, air-tight joint.

One of the features of this particular job is the ease and simplicity of its operation. Induction heating is applied instantly by push button control. A continuous flow of production follows at the rate of approximately 300 units an hour. Skilled labor is not necessary. After the preliminary setup no adjustment need be made—the operation is automatic. With this process it was possible to perform three brazes simultaneously in 35 seconds.

Three units are brazed at one time. The strength of the braze is as high or higher than the original metal. As this joint is free from internal oxidation, the need for cleaning or other operation is greatly reduced The temperature is controlled exactly to the brazed area and areas adjoining, with no annealing beyond, and no metallurgical change.

The effectiveness of this particular job may suggest other brazing or metal-treating operations which will facilitate the production and decrease the cost of labor and materials.

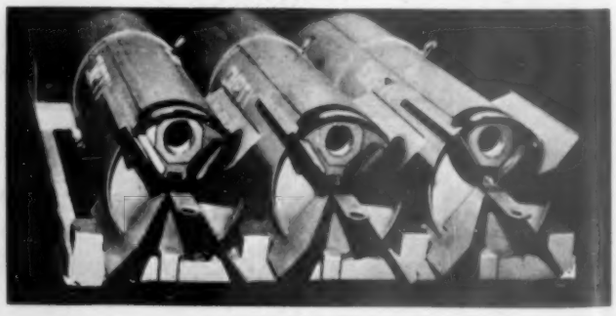
» «

"Wrinkles" for a Skid

By C. C. LYNDE

Wrinkle-bending of pipe is usually done to obtain a slight change in direction, and the production of the wrinkles is incidental to the operation. To insure a safe grip on the ends of pipe skids under oil-well drilling equipment, however, one weldor devoted his time and attention to making heavy

(Continued on page 54)



Induction heating was used to melt a pre-placed ring of silver alloy, making it possible to accomplish the brazing of these three units simultaneously within 35 seconds. A perfect airtight joint was formed on each unit.

Photo Induction Heating Corp.

New PAGE ELECTRODE *helps to Speed tank production*

Reading Time: 43 seconds

☆ *How many additional land battleships roll into action because of the new electrode* PAGE *developed for armor welding? Not until Victory brings Peace can it be told.*

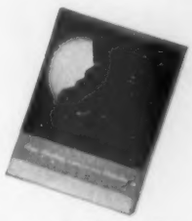
You may be sure, however, that PAGE *was ready when the tremendous advantages—the greater speed—of welded construction were appreciated.*

And you also can be certain that this new PAGE *electrode successfully met all ballistic tests on plates submitted to the Army Ordnance Department by the tank manufacturers.*

Keep in mind the effect of this wider use of welding—and welding in shipyards—on your own job. See that you are using electrodes of the most economical sizes—lean toward larger diameters. Use them down to the holder. Check to prevent deposit of excess metal in the weld.

PAGE STEEL AND WIRE DIVISION

Monessen, Pa., Atlanta, Chicago, New York, Pittsburgh, San Francisco



If you are welding Stainless Steel, ask your local Distributor of PAGE *Electrodes for this booklet on* PAGE-Allegheny Stainless Steel Electrodes. *It is helpful.*

One of the new American welded tanks

AMERICAN CHAIN & CABLE COMPANY, Inc.

BRIDGEPORT • CONNECTICUT

(Continued from page 52)

wrinkles across the extended ends of the skid members, so that a chain or winch line could be looped around the corrugated surface thus formed and eliminate all danger of slipping.

To obtain extra deep wrinkles, the area heated by the torch was made more than twice the usual width for pipe of the weight used, and the wrinkle formed by a sharp tug at the end of the pipe rather than a slow, steady pull. The pipe was longer than necessary to provide leverage for bending. By confining the heating to a lens-shaped area on the upper half of the pipe, the lower or sliding edge of the skid was kept smooth, so as to offer as little resistance as possible to moving the unit.

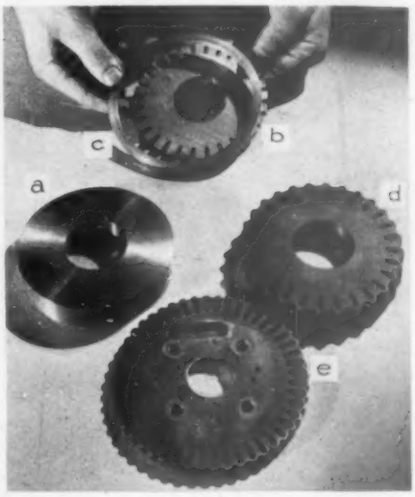
These extra-deep wrinkles were obtained by heating a comparatively large width of pipe with a torch, then giving the pipe a sharp tug rather than a slow, steady pull. Heating was confined to upper half of pipe.

After setting the desired wrinkles, the extended end of the pipe, used as a lever, was cut off and a section welded in to close the pipe.

» «

Brazed Die Strippers

A simplified method of making die strippers increases the life of metal stamping dies and improves the quality of stampings for the Westinghouse Electric & Mfg. Co. Stripper accuracy is equal to that of the die, and the manufacturing cost is 1/3 to 1/15 that of the former conventional method of making the stripper in one piece by laying out, jig boring, sawing and hand-filing the slots.



Copper-brazing makes possible machine-milling instead of the former hand working of stripper slots at the Westinghouse Electric and Mfg. Co.

Steps in the new method are illustrated in the accompanying picture. A disk of the proper grade of tool steel (A) is machined to the outside diameter of the slot edge. A milling machine then cuts equidistant slots, transforming the disk into the spider B.

Over B is shrunk the outer ring (C), and the two are copper-brazed in a controlled atmosphere furnace at 2050 F. The brazed assembly is then machined and is ready for use (D). A one-piece, hand-filed stripper (E) made by the old method is shown in the foreground.

In making motor laminations, the purpose for which these strippers are used, the clearance between the punch and the die is usually in the order of .001 in., and the stripper must fit almost as accurately as the die itself.

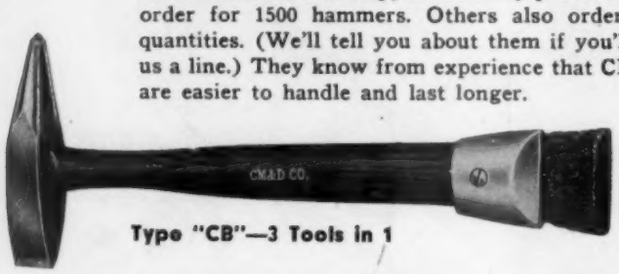
CM&D CO.

For 17 Years

The Leading Trade Name In Weld Cleaning Tools

Here's Why

Since 1925, CM&D tools have been preferred for cleaning and brushing slag, spatter and welds. Now thousands are speeding up welding operations in the war industries. One shipyard recently placed a repeat order for 1500 hammers. Others also order large quantities. (We'll tell you about them if you'll drop us a line.) They know from experience that CM&D's are easier to handle and last longer.

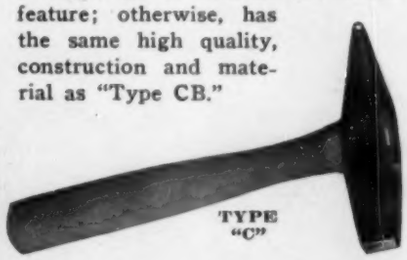


Type "CB"—3 Tools in 1

This sturdily built, combination drift-chisel hammer is a standby for fast cleaning. . . . Can be manipulated from any position. . . . Operates efficiently in close quarters.

Welders can chip and brush with one hand and weld with the other. Three tools for the price and convenience of one.

"Type C" is without the brush feature; otherwise, has the same high quality, construction and material as "Type CB."



Make weld cleaning and brushing easier, spend more time welding with CM&D tools. Get them from your jobber or write directly to . . .

CHICAGO MANUFACTURING & DISTRIBUTING CO.

1928 W. 46th STREET, CHICAGO, ILL.

Welded Joints — Good and Bad*

Fig. 1 is a poor method of joining sheet metal. There is very apt to be a layer of oxide in the joint.

Fig. 2 will make a better joint than *Fig. 1* but it is inconvenient to prepare the metal this way.

In angular joints like those in *Figures 3 and 4*, the arrangement shown is more advisable than overlapping as in *Fig. 5* or *Fig. 9*.

Figs. 6, 7, 8 and *10* are further examples of joints that can be made without preparing the parts although *Fig. 7* is not apt to prove a strong joint.

Figs. 11 and *12* are the simplest designs for ordinary butt welds.

Fig. 13 is a method that should never be used. A good weld cannot be secured this way.

When making a right angle joint between thick plates, *Fig. 14* is preferable to *Fig .8*.

Two other good methods of making this type of joint are shown in *Figs. 15* and *17*. *Fig. 16* is a very unsatisfactory arrangement.

Fig. 18 will probably produce a better joint than any of the four methods just mentioned.

The methods shown in *Figs. 19* and *20* are sometimes used but do not appear to be good practice.

Fig. 21 shows a preparation that will give the strongest joint between three pieces.

Figs. 22, 23 and *24* make a good joint if the work is carefully done but this sort of design requires the use of a great deal of filling material.

If the weld is made as shown in *Fig. 26*, there is danger of not securing penetration. This danger can be overcome by preparing the parts as shown in *Figs. 25* and *27* but welding on a design of this kind should be trusted only to skilled workmen.

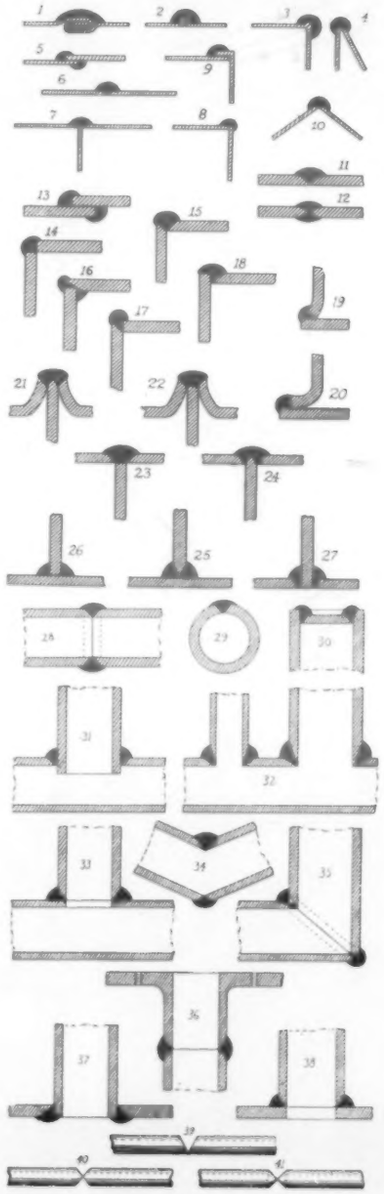
Fig. 28 illustrated the beveling necessary when butt welding tubes.

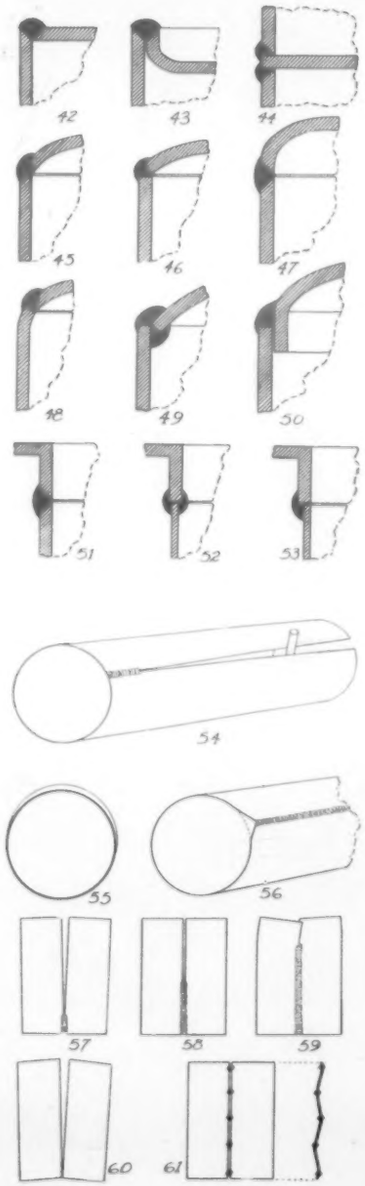
Fig. 29 shows how the weld should be made in the longitudinal seams of tubing.

Fig. 30 is a good arrangement for welding a bottom in a cylindrical tank.

Figs. 31, 32 and *33* illustrate the joining of tubes at right angles.

*From the 10th Edition, The Welding Encyclopedia.





Figs. 34 and *35* are two other methods of making angle joints in tubing.

Fig. 36 illustrated the use of a specially made flange for tube welding.

Figs. 37 and *38* show two methods of building a flange on the end of a tube. *Fig. 37* is probably the better method but the welding will prove more difficult.

Fig. 39 shows the beveling for small round rods.

Fig. 40 shows the beveling for larger rods.

When rods are to be butt welded, the ends should never be turned to a point as shown in *Fig. 41*.

The seam around the bottoms of tanks can be prepared as in *Fig. 42* if they do not have to be very strong.

Fig. 43 is a good method of welding bottoms in gas containers.

Fig. 44 is a good strong method of welding in a partition.

Figs. 45 and *46* are rather undesirable methods of welding bottoms on cylinders. *Fig. 47* is much better. *Figs. 48, 49* and *50* are three more undesirable types.

Fig. 51 is simply another illustration of butt welding pieces of the same thickness. If pieces not of the same thickness are to be butt welded, do not use the method in *Fig. 52* if it can be avoided for the method shown in *Fig. 53* will save filling material and give a better joint provided the operator is careful to manipulate his torch so that both pieces are melted at the same time.

Fig. 54 shows the use of a wedge in welding cylinders in order to keep the edges properly separated. If the seams are tacked before the welding starts, the cylinder will be distorted in *Fig. 56*. *Fig. 55* shows a distortion that is apt to take place when bottoms are welded in cylinders.

Figs. 57, 58, and *59* show what takes place when sheets are butt welded with the edges parallel at the beginning of the operation. The sheets first separate a little, then drawn together and finally overlap. This can be overcome by separating the sheets as in *Fig. 60* or by tacking them in *Fig. 61*.

Mayari R steel that would ordinarily have been used to make box cars, trucks, buses—or even coal-grab buckets—is now being devoted to the making of planes, tanks and guns.

The need for fighting equipment of all kinds needs no emphasis, and Mayari R has been applied to hundreds of parts, particularly in mobile equipment where its weight-saving is so great an advantage.

When peace comes again, this high-tensile, low-alloy steel will be even better and more useful, as continuous research and new applications are leading to improvements and refinements. Mayari R then will help you to make your products stronger, lighter, more efficient, better able to meet the challenge of competition.

Physical properties of Mayari R:

Ultimate tensile strength, p.s.i., minimum	70,000
Yield Point, p.s.i., minimum	50,000
Elongation in 2 in. per cent minimum	22
Endurance limit, p.s.i.	50,000
Endurance ratio	0.70
Modulus of elasticity	28-30,000,000

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

New Product Developments

Single dial permits easy selection of more than 60 heats on the new US A-C arc welder.

A-C Arc Welder

★ A transformer type A-C arc welder with eight coils, featuring more than 60 heat selections from 20 to 350 amps., is announced by the **US Electric Welder Corp.**, 1224 W. Bancroft St., Toledo. The new **Protected Arc Welder** is adjusted to the work by setting its single control—a dial calibrated to carefully determined welding amperages. No other adjustment or attention is required while that job is being done, states manufacturer. Combination heat and voltage adjustments are said to permit welding of anything from 20 or 22 ga. sheets up to heavy locomotive frames and parts. The welder is equipped with a ventilating fan which cools the coils when they are called upon to deliver a current for heavy welding applications.

Machine measures 21 in. long, 14 in. wide, 23 in. high; weighs, 240 lbs. It will use any type of A-C welding rod.

» «

"Bomb-Quench"

★ A disappointing reception awaits Axis incendiary bombs falling here, according to chemical laboratory and metallurgists' reports on a new extinguisher, **"Bomb-Quench,"** developed specifically for the fighting of magnesium fires. The person extinguishing the fire stands a safe five ft. from the blaze, removes the top from the 5 ft. long container tube and sprinkles the extinguisher powder over the bomb's burning magnesium. Simulated incendiary bombs, both weighing more than the ordinary fire bomb, were extinguished within 42 seconds and 65 seconds respectively in a public demonstration in front of the Safety Building in Milwaukee.

Further details may be obtained from the **O. H. Adams Co.**, 2018 East Thomas Ave., Milwaukee.

All-Position A-C Electrode

★ An all-position, high-quality alternating-current electrode, **Type W-26**, which is said to extend the advantages and convenience of **high-quality** A-C welding to both vertical and overhead positions, has been announced by the **General Electric Co.**

The W-26 has been developed to fulfill a long felt need for a vertical and overhead A-C welding electrode that would give a high-quality job from the standpoint of physical characteristics as well as easy operation, adequate penetration, and practically flat fillet contour.

Type W-26 electrode complies with the requirements of the following specifications: A.W.S. Filler Metal Specification E6011; Navy Bureau of Ships Specification 46E3, Grade 3, Class 1; and the A.S.M.E. Boiler Code, Paragraph U68.

Type W-26 electrode is claimed comparable to the highest quality vertical and overhead welding characteristics available from reverse polarity direct-current electrodes. It is said to provide a strong, forceful arc having good fusion, excellent penetration, and uniform characteristics free from arc blow. It is now available in ⅛ in. and 5/32 in. diameters; other sizes from 3/16 in. to ¼ in. are expected to be available shortly.

» «

Tool Stands

★ The new **Lyon Tool Stands** provide individual tool storage for workers on one, two or three shift operations. Stands may be used as parts and tool transporters for maintenance men, equipment carriers for inspectors, for stock picking and transportation and on assembly lines. Stands are made with one, two or three drawers. Drawers are easy sliding and may be locked to safeguard valuable tools. **Lyon Metal Products, Inc.**, 3177 Clark Street, Aurora, Ill.

Workers may now have handy tool storage with these one, two or three drawer tool stands.

» «

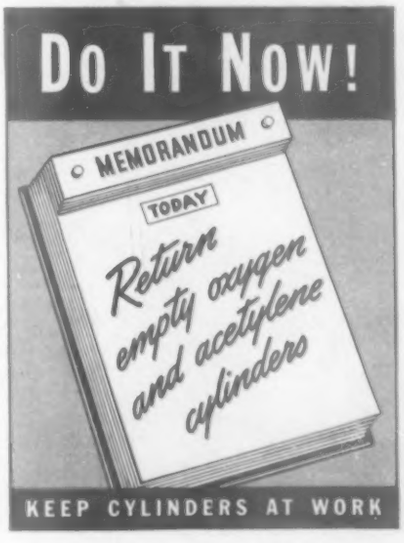
Carbide Floodlights

★ For construction and repair work, for routine railroad checking jobs or for any emergency use, **National Carbide Corp.**, 60 East 42nd St., New York City, now offers its new **NC-200** model. The unit, the largest now being made, has two 8,000 cp floodlights constructed on swing joints, thereby allowing inpendent directional control with 16,000 cp concentration of light. This portable floodlight may be used continuously or intermittently and is always ready for instant use until the carbide charge is exhausted.

» «

Flux for Tool Joining

★ For joining carbide and all other types of cutting tips and cutting blades to tool shanks, **Krembs and Co.**, 671 West Ohio St., Chicago, offers a specially developed **"Fluxined-Spelter."** This is brushed on the contacting surfaces of both the cutting tip and the tool shank. The work is then assembled to form a tight fit and brazed. Either furnace, torch or spot-welding methods can be used, and the method is adapted to both small and large scale production. When completed, states manufacturer, the finished braze looks like a gold-plated joint, with no waste of joining material and very little scale-cleaning required.



Spatter Preventative

★A new means of spatterproofing, said to eliminate all spatter-cleaning and prevent pitting on stainless steel and galvanized material, is announced by **G. W. Smith & Sons,** 79 So. Sperling Ave., Dayton, O. The compound, known as **Protect-O-Metal No. 2,** is brushed down the seam and on the surrounding surfaces where spatter usually collects. It may be used on either single or multi-pass welds, any amperage, and is said to have a stabilizing and quieting effect on the arc.

After welding, surfaces are merely wiped with a damp cloth to remove compound and provide a clean surface suitable for paint finish. No grinding, scraping or washing is necessary, states manufacturer.

» «

Air-Cooled Arc Welder

★**Ergolyte Manufacturing Co.,** Lawrence Street at Erie Ave., Philadelphia, has brought out a new heavy-duty air-cooled A-C arc welder, **Model 250 F.** This new model contains a built-in cooling system, which, according to Ergolyte engineers, reduces the thermal stress which tends to strain the insulation and shorten the life of an arc-welding machine.

Forced draft cooling is a feature of this new A-C arc welder.

The 250 F will handle electrodes from 1/8 to 1/4 in. It operates on 60-cycle, single phase, 230 v., A-C and has a current range from 15 to 250 amps. There are 24 heat steps.

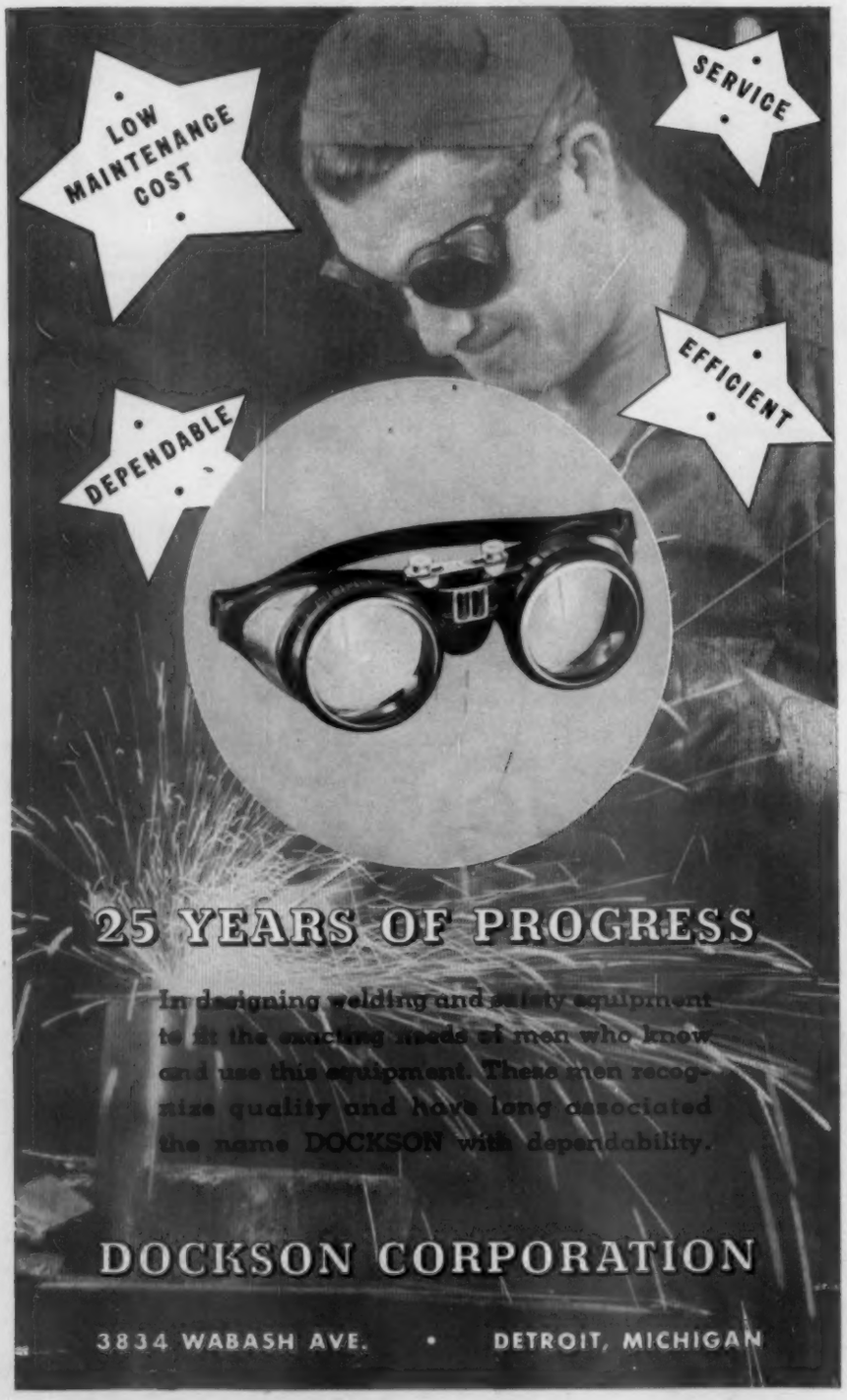
» «

Welding and Brazing Fluxes

★A new line of **welding fluxes** for both ferrous and nonferrous metals has just been released by the **National Cylinder Gas Co.,** 207 W. Wacker Drive, Chicago. Claimed for the entire line is the ability to adhere to hot rods in the proper proportion. Fluxes are packed in wide mouth, non-tipping containers as shown on page 61.

National No. 1 is a flux for welding cast iron, said to float to the surface the heavy oxides which form during welding and keep them liquid so that a dense, non-porous and ductile weld can be produced. No. 2 is a cast iron brazing flux, stated to produce a good bond at low base temperature and hold the bronze being applied at a uniform molten consistency.

No. 3 brazing flux is suitable for brass, bronze, copper, steel and malleable iron. According to manufacturer, it reduces atmospheric oxidation, keeps flux glaze at a minimum and promotes thorough tinning and cleaning because


LOW MAINTENANCE COST
SERVICE
EFFICIENT
DEPENDABLE
25 YEARS OF PROGRESS
In designing welding and safety equipment to fit the exacting needs of men who know and use this equipment. These men recognize quality and have long associated the name DOCKSON with dependability.
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3834 WABASH AVE. • DETROIT, MICHIGAN

A bulletin describing the new National line of welding fluxes is available on request.

of the ability of the flux to run well ahead of the weld puddle.

No. 22 is an aluminum flux for sheet, cast, wrought and aluminum alloys. Fluxing action is declared to be fast and effective in floating out the oxides and other impurities formed during aluminum welding.

» «

Weldmask

★ **Turco Weldmask,** a creamy white protective liquid, was designed to prevent spattered molten particles or "dingleberries" from attaching themselves to the area surrounding a weld. Liquid is applied with a brush to about 3 in. on both sides of the joint. The welding is done through the coating, which, states the manufacturer, has been proved by tests to have no effect on the fusion of metals. The residue and molten particles can be removed with a hand and wirebrush after welding.

This liquid can be used on steel, stainless steel, aluminum or magnesium. It is non-inflammable, does not give off fumes and is non-injurious to the skin, hands or face. Because it does not dry on the work, it may be applied either immediately or several hours before welding. **Turco Products, Inc.,** 6135 So. Central Ave., Los Angeles.

» «

Electric Hoisting Trucks

★ **Clark Tructractor Div.** of Clark Equipment Co., Battle Creek, Mich., is now introducing a line of **storage battery powered vehicles** for use in the war production program where electric operation seems best fitted to the particular job.

These machines lift from 2,000 to 7,000 lbs., using an hydraulic vane type pump driven by a series wound motor. The same pump operates the tilting unit, enabling the operator to tilt the load back 10 deg. for safe riding and tilt it forward 3 deg. for tiering. The trucks will climb 7½% grades under their maximum loads. Standard equipment includes hydraulic brakes, centrally located control levers, spring-mounted seats, disc type wheels, electric horn. Customer has his choice of Edison alkaline battery or any standard make of acid battery.

PASS IT ON!

Pass your welding information along to your fellow workers! Some of the fellows with whom you are working do not have the opportunity to read *The Welding Engineer*. When you are finished with this issue, pass it on—help your fellow workers keep abreast of new developments through the pages of *The Welding Engineer*, the world's first and oldest exclusive welding magazine.

NEED WELDERS?

LET'S NOT waste time with fancy "copy" or high-sounding words! The object of this ad is to contact YOU if you are now—or will be—in need of welders, either gas, arc, or combination.

ANSWER THIS AD!

These men are U.E.I. trained in our own shops and have passed code-prescribed tests probably as tough as your own. Are they good? Judge for yourself. U.E.I. welders are working for Delta, Mobile, Calumet, and other ship-builders; for International Harvester, Vacuum Can, the Navy, the Army Air Corps Training School, Diamond T — and plenty more places where welders have to know their stuff to make the grade. Right now we have a few who are ready, and soon we'll have more. So RIGHT NOW, tell us what you want and how many. Send us your applicant's blanks. We'll do our best to put you in touch with the type of men you want to work for you. There is no obligation.

U. E. I.
Nationally recognized training center specializing at this time in WELDING.
Established in 1927

Write— Right Now

In your own interests, we urge you to anticipate your need for welders and let us know NOW.

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Ideal FOR AIRCRAFT WELDING
TWECO "HOL-GRIP JR."

Small
actual size
Light Weight
only 8 ounces
Strong

For Aircraft ...and ALL other Light Gauge Welding

STEP UP PRODUCTION . . ELIMINATE OPERATOR FATIGUE

The Aircraft Industry is really taking to this strong little holder. Above is its actual size. It's fully insulated; 7 inches long; 150 amperes capacity; takes electrodes through 5/32 in.

TWECO PRODUCTS

Tweco "HOL-GRIP JR" makes close quarter work on all light gauge metals a lot easier. It takes a positive grip on the electrode at any desired angle. Work spoilage through accidental arcing is cut to a minimum. All Conductor parts are 98% Copper Alloy and the spring is insulated against burnout.

Convert Heavy Duty Holders for Light Work

Take heavy duty and light work as it comes . . . the easy way. Heavy duty holders can be converted quickly to light work with combination "Hol-Grip Jr" and Whip End Cable attachment. Cable has a connection lug that clamps right into regular heavy duty holders. On completion of light work, the whip cable and "Hol-Grip Jr" can be quickly detached. Get this combination today for versatile operation.

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COLMONOY SAVES VITAL METALS

The Pug Knives shown above tell a graphic story of the unusual wear resisting qualities of COLMONOY hard-surfacing alloys and overlay metals.

1. New, 24 lb. pug knife, made of high alloy steel.
2 and 3. Same type, after only 3 months of service. Worn beyond efficient operation, with the loss of over half of blade material.
4 and 5. Same type. Each blade coated with 1½ lbs. of COLMONOY No. 6. In constant use for over a year, and still operating efficiently.

COLMONOY alloys are playing a vital part in the welding industry. Welders are using them to hard surface parts subject to severe wear, resulting in increased efficiency and production.

Write for Full Information

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Buhl Building, Detroit, Mich.
Branch Offices at New York City, Blasdell, N. Y., Chicago, Tulsa, Whittier, Calif. Other Branches in Canada

News of the Industry

Those in our Nation's Armed Forces may continue to read The Welding Engineer at the special reduced price of $1.50 per year for the duration.

» «

A.I.E.E. Discusses Electronic Control of Resistance Welding

A conference on Electronic Control of Resistance Welding was held June 24 at the Drake Hotel, Chicago, as part of the summer convention of the **American Institute of Electrical Engineers.** S. B. Ingram, Bell Telephone Laboratories, chairman of the A.I.E.E. joint subcommittee on electronics, presided.

The object of the conference was to obtain an informal interchange of opinions and experiences on various types of electronic systems for resistance welding. The meeting was opened with brief talks by the two discussion leaders: G. W. Garman, industrial department, General Electric Co., and E. H Vedder, manager, electronic control section, Westinghouse Electric and Mfg. Co.

Mr. Garman presented the case for A-C single phase resistance welding with electronic controls. Mr. Vedder presented the case for electronically controlled stored-energy welding. The balance of the session was devoted to informal discussion from the floor on various phases of thyratron and ignitron tube construction and their applications to resistance welding.

» «

New Radio Programs on "The Engineer at War"

Beginning July 16, the National Broadcasting Co., will broadcast from 6:30 to 6:45 p.m. over its nationwide network a series of 11 radio programs dealing with the contributions of engineers to the prosecution of the war.

The material was prepared under direction of a committee representing the American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Chemical Engineers.

Among the programs are several which might be of special interest to welding engineers. The subjects and dates are: "The Resistance of Structures," July 30; "Dry Docks and Ship Repair Bases," Aug. 13; "Tanks and Tools," Aug. 20; "Airplanes," Aug. 27; "Petroleum Production," Sept. 3.

» «

The **Keystone Carbon Co.**, St. Marys, Pa., manufacturers of precision moulded products, are completing a large program of expansion including plant and production facilities. This project was necessary due to the increased demand for materials produced by powder metallurgy.

Victor Equipment Co. is now handling the complete line of stainless and alloy electrodes manufactured by **Arcos Corp.**, Phila., Pa. This organization, which is well known on the coast, has sales offices in Los Angeles, San Francisco, Fresno, Bakersfield, and San Diego, California, as well as in Phoenix, Arizona. Inquiries should be addressed to the nearest office.

Personals

Herman W. Steinkraus, formerly vice-president and general manager, has been elected president and general manager of the **Bridgeport Brass Co.**, Bridgeport, Conn.

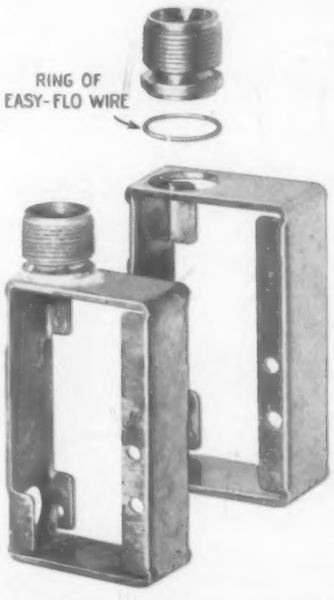
» «

William M. Black was made a vice-president of The American Brake Shoe and Foundry Co. at a recent meeting of the Board of Directors, according

(Continued on page 65)

EASY-FLO

Triples brazing output on this war product!



After parts are cleaned and fluxed, stud is placed in position on a frame with a ring of Easy-Flo wire between. Brazing is done in a gas furnace. Note the penetration and the clean joint in the finished job. Preplacing the alloy, fast heating, and elimination of joint cleaning contributed to the 200% increase in production with Easy-Flo.

Here is an example of how Easy-Flo—the low temperature, fast-acting silver brazing alloy—is helping to step up production on hundreds of war products.

The job illustrated consists of joining a steel stud to the steel housing of Micro Switches, being produced entirely for war purposes, mostly aircraft. This job was formerly done with a high melting point base metal alloy. The change to Easy-Flo boosted production **from 500 to 1500 per day.** What's more, it **increased joint strength** far above the previous method and **cut costs** to such an extent that the price of the switches was lowered.

IT'S EASY TO CHANGE TO FAST, RELIABLE EASY-FLO BRAZING

Easy-Flo brazing procedure is simple and usually requires no radical design changes. In quick time you can put it to work in your shop and get the benefit of the higher production and better joints it assures. Bulletin No. 12 tells you how to do this—also gives full details about Easy-Flo plus valuable information about joint designs, heating methods, production procedures, etc. Write for a copy of Bulletin No. 12 today.

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• • • it wouldn't frighten you—neither will you be afraid to weld broken dies and tools when you use Eureka Tool Steel and Alloy Welding Rods. We can give you full instructions as to the proper rod for each and every job and fully acquaint your welding department with correct procedure upon receipt of your inquiry.

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Solve 90% OF YOUR HARD SURFACING PROBLEMS

AGILE DARK GREEN
ELECTRODES DO THE JOB!

For the forming of dies and for the building up and reinforcing of surfaces and edges damaged by abrasion, you can't beat Agile Dark Green. Brinell Hardness 420-600; 45 to 60 Rockwell C.

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TO MEET SPECIFIC WELDING REQUIREMENTS

Use PERFECTION
WELDING ELECTRODES

PERFECTION P-60
For Single Pass Fillet Welds . . .

Here is a coated electrode designed especially for single or multiple pass welding of all types of mild steel sections where the fit-up is bad —for single pass fillet welds in marine and tank construction, structural assemblies and machine bases.

"Perfection" arc welding electrodes are manufactured to strictest specifications with the same care of making the finest quality "Perfection" rivets for 30 years—used throughout the United States in all classes of steel fabrication.

Write for our catalog describing uses and characteristics of various Perfection electrodes for use on Mild Steels, Cast Iron, Carbon Moly and Low Alloy High Tensile Steels.

THE ANTHONY CARLIN CO.
2717 East 75th St. CLEVELAND, OHIO

Personals

(Concluded from page 63)

to an announcement just made by W. B. Given, Jr., president. The appointment became effective at once.

Mr. Black has been president of the American Manganese Steel Div., American Brake Shoe & Foundry Co. since 1940 and will continue in that capacity. He joined this division in 1912 and became its general sales manager in 1934 and vice-president in 1935. Mr. Black served as a lieutenant of ordnance in World War I.

» «

H. W. Foege has been made sales manager for the mid-western states of **Eutectic Welding Alloys, Inc.,** New York City. Mr. Foege has been with this company for more than a year, working in the Chicago territory. He was formerly district sales manager of the Keystone Steel and Wire Co.

» «

L. Abbett Post has been engaged to fill the newly created position of manager of the **American Institute of Steel Construction,** New York City. During the past year he has been attached to the construction branch, production division of the War Production Board. Mr. Post's appointment does not otherwise alter the staff of the Institute in personnel nor affect its functions.

» «

Richard F. Bergmann has been appointed chief engineer of the Link-Belt Co., Chicago. He was once assistant to **W. W. Sayres,** former chief engineer, who has been appointed consulting engineer for the company. Mr. Bergmann returns to Link-Belt from the Rayon Machinery Corp., Cleveland, of which concern he was chief engineer.

» «

Burton H. Gedge, formerly assistant to vice-president in charge of operations of American Steel & Wire Co., has been promoted to new duties, specializing in production activities of the vice-president's office. **Harry L. Jenter,** formerly superintendent of the Cuyahoga Works, has also been made assistant to vice-president and will concentrate in office work for the vice-president.

» «

J. Dell Baster, formerly superintendent of cold rolling at Cuyahoga, has been promoted to the position of general superintendent. **Charles M. Sackerson** has been appointed superintendent of the cold rolling mills at Cuyahoga, and **James W. Futhey** has been made general foreman of cold rolling.

» «

Scully Steel Products Co. announces the appointment of **L. F. Niemann** as district manager of its St. Louis warehouse and **J. K. Rittenhouse** as district manager of its Twin City warehouse at St. Paul, Minn.

Current Reviews

Labor Arbitration

The first comprehensive book on labor arbitration ever issued in the United States is announced for publication by mid-summer. Entitled **"Labor Arbitration — Principles and Procedures,"** it is the work of Dr. John A. Lapp, whose knowledge and experience in this complex field are matched by only a few men in this country. The author has arbitrated over 400 cases in the last ten years, covering the terms of new contracts, grievances under labor contracts, jurisdictional disputes, interpretations of contract provisions, etc., etc.

Dr. Lapp has served both private organizations and public departments. He was Chairman of the Coal Labor Board II Division, member of the Petroleum Labor Policy Board, Head of Labor Relations for the Public Works Administration, Labor Advisor to the Rural Electrification Administration, Referee of Jurisdictional Disputes for the Building Trades, Referee National Railroad Adjustment Board.

He has been chosen by labor and industry as arbitrator in many important disputes on wages and working conditions, involving such nationally-known organizations as Carnegie-Illinois Steel Corp. and Steel Workers' Organizing Committee, Columbia Broadcasting Co. and International Brotherhood of Electrical Workers,

(Continued on page 66)

★ ATLAS ★

Cut your Weld Cleaning costs by equipping your welders with Atlas Weld Cleaners. Many models and weights to choose from. Select the model most adapted for your work and standardize. Specify Atlas.

No. 1
ATLAS No. 1 TOMAHAWK
Double Chisel Head. Flex-O type Handle—Built in standard and heavy weights.

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ATLAS No. 2 TOMAHAWK
Cone and Chisel Head. Flex-O type handle. Built in Standard and Heavy duty weights.

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ATLAS No. 3 TOMAHAWK
Double Chisel Head. Steel reinforced wood handle. Built in standard and heavy duty weights.

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WRITE FOR ATLAS FOLDER ILLUSTRATING AND DESCRIBING OTHER MODELS

Contact your Dealer—if he doesn't handle the Atlas line, write direct for the tools you are interested in.

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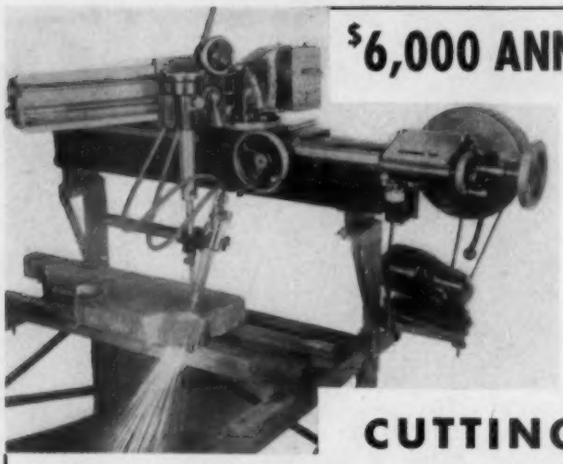

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Reduce machine finishing operations — sawing, drilling and milling — to a minimum. With a SCHOITZ you save on both material and labor —both time and money.

Save critical tool steel and avoid delays in getting proper material. Cut down your shaving piles and resulting high labor costs. A few sizes of steel plate replaces large inventory of bar steel-flats and rounds. With a Schoitz Cutting Machine you always have the right size for the job.

Pays for itself—even in small shops—in less than a year.

IMMEDIATE DELIVERY—GET DETAILS

Write today for new folder giving all data and useful information regarding chart and indicator giving proper cutting speed in sizes and working pressure for any thickness material.

√ Saves Time
√ Avoids Delays
√ Reduces Costs

Typical Time Savings With the Schoitz Flame Cutter

Chuck Jaw—2½ hrs. to 6 min.
Jig Plate—4 hrs. to 8 min.
Face Plate—3½ hrs. to 20 min.
Tool Block—3 hrs. to 10 min.
Vee Block—2 hrs. to 7 min.
Stripper Plate—5 hrs. to 15 min.
Bolster Plate—4½ hrs. to 11 min.
Heel Clamp—2 hrs. to 6 min.
Gear Blank—3½ hrs. to 7 min.
Die Shoe—5 hrs. to 14 min.

SCHOITZ ENGINEERING WORKS
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ISOROD SELF-HARDENING FORGEABLE ALLOY ELECTRODE

FEATURES of deposited metal—

BRINELL 520 to 560 Rockwell 52-56 TENSILE STRENGTH above 180,000 P.S.I.
LOW SPATTER LOSS—less than 10% including flux
APPLICATION—to all irons and steels including stainless
DEPOSITS—truly forgeable without checking or loss of hardness

USES — for armoring all rock handling and dredging equipment such as shovel teeth, tractor treads, centrifugal pumps, crushing mantles, guide and thrust rollers, sprocket gears.

PRICES AND SIZES—

¼" dia. x 14" long end grip electrodes....50c lb. 5/32" dia. x 14" long end grip electrodes....58c lb.
3/16" dia. x 14" long end grip electrodes....50c lb. ⅛" dia. x 14" long center grip electrodes....65c lb.
3/32" dia. x 14" long center grip electrodes..75c lb.

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TRADE-MARK REGISTERED

Resisto-Loy hardfacing is an extreme duty rod, deposits of which must withstand severe abrasion and heavy impact without chipping. Highly efficient on diesel and high pressure steam valves and seats. Deposits will not score.

PRICED FROM $1.50 PER LB. 5/16" DIA.

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PURITY CYLINDER GASES, INC.
Grand Rapids, Kalamazoo, Lansing, Michigan
SOUTHERN OXYGEN CO.
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Westview, Pittsburgh, Pa.

RESISTO-LOY COMPANY GRAND RAPIDS MICHIGAN

BUY WAR SAVINGS BONDS AND STAMPS

Current Reviews

(Continued from page 65)

Consolidated Edison Co., Shell Petroleum Corporation, Boeing Aircraft, North American Aviation, etc.

It is a unique background, and Dr. Lapp has written a truly unique book of great timely importance now that arbitration of labor disputes seems destined to become national policy. As the first authoritative and detailed guide to labor arbitration procedure, replete with actual examples, this book should prove of great practical value.

The publishers, **National Foremen's Institute,** Deep River, Conn., who report considerable advance interest in Dr. Lapp's book, have set August 15th as the day of publication.

» «

Weld Inspection Chart

The Lincoln Electric Co., Cleveland, has just published an **arc welding inspection chart** which will provide welding inspectors with much helpful data arranged for quick and easy reference. The chart presents photographic reproductions of the different types of welds obtained when the work is done normally (with normal current, voltage and speed) as compared with welds obtained when these factors are not normal. Plan and elevation views of fillet and flat beads are given to show the effects on the resultant welds of such conditions as too low current, too high current, too low arc voltage, too high arc voltage, too low speed and too high speed.

Accompanying the pictures is a table indicating the burn-off of the electrode, the penetration of fusion, the appearance of bead and the sound of the arc with each value of current, voltage and welding speed.

» «

Welding Equipment Catalog

Mindful of the Government's plea to conserve the man power and tires ordinarily used by salesmen, the **Victor Equipment Co.,** San Francisco, has produced the largest and most comprehensive **catalog** in 20 years to make its approach to the welding industry. The 64-page book, profusely illustrated, is designed to assist the manufacturer in making a wise selection of flame welding and cutting apparatus. There are many colored illustrations and scores of black and white reproductions of parts and equipment.

» «

Radiography Manual

Radiography—photography by means of gamma-rays—has now become a thoroughly tested method for revealing hidden interior defects. To acquaint the layman with the fundamentals of this science, the technical staff of the **Canadian Radium & Uranium Corp.,** Rockefeller Center, 630 Fifth Ave., New York City, has just issued an 80-page **"Manual on Industrial Radiography with Radium."**

The chapter on "The Radiography of Welds," beginning on page 53, will be of particular interest to the welding fraternity. Radiographs of actual welds are reproduced to illustrate the most commonly found defects in welding; namely, porosity, entrapped slag, lack of fusion and cracks.

Though this book is written primarily for beginners, a digest of recent advances in industrial radiography is included for the benefit of the more experienced.

» «

Maintenance Hints Notebook

To help keep the tools of war industries in full operation, a two-volume set of maintenance rules and suggestions has been written by engineers of the **Westinghouse Electric and Mfg. Co.**

The books total 220 pages and are made up of 15 chapters for loose-leaf insertion in 5 by 7 in. binders. Volume one covers inspection of electrical apparatus, insulation materials and applications, the cleaning, drying and testing of insulation, commutator maintenance, starting and regulating of A-C, D-C and squirrel cage induction motors. Volume two is devoted to contactor maintenance, the inspection of transformers and a chapter on transformer connections.

Copies of **maintenance hints notebooks** are available to maintenance men from Department 7-N-20, Westinghouse Electric and Mfg. Co., East Pittsburgh.

» «

Resistance-Welder Control

Synchronous thyratron control for resistance welding machines is described in an 8-page booklet, **GEA-2791C**, just published by the **General Electric Co.** Thyratron control for spot and projection welders, according to a discussion in this book, provides these advantages: (1) improved quality of weld, (2) low maintenance cost, (3) noiseless control, (4) increased welding speed, (5) consistent welding with short timing, (6) easy welding of dissimilar metals, (7) precise timing for projection welds, (8) smoother adjustment of heat over a wide range, (9) small floor space required.

Spot-welder control ratings and specifications are tabulated. Many different types of equipment are illustrated.

» «

Oxy-Acetylene Cutting

The Oxy-Acetylene Committee of the **International Acetylene Association,** 30 East 42nd St., New York City, has just completed a second revision of its 60-page pamphlet entitled **"Oxy-Acetylene Cutting."**

This booklet was originally prepared in 1934 and first revised in 1937. Principle change in the latest revision is to clarify through better arrangement the table showing the cutability of ferrous metals. Other material has been added to bring this table and the notes connected with it wholly up-to-date.

» «

Inspection of Welding

The American Welding Society has recently approved and published a committee report on the above subject, entitled **Recommended Practices For Inspection of Fusion Welding.** This report is the result of two years work by the Committee and represents a comprehensive treatment of the many factors involved in the inspection of welds made by the arc and oxy-acetylene processes. The subjects covered include: qualifications of welding inspectors; duties of inspectors; inspection and testing of welded structures; inspection during construction; shop and field inspections; examination of welds; radiographic inspection, hydrostatic testing and magnetic powder inspection. A considerable part of the report deals with the welding characteristics of both ferrous and nonferrous metals. These sections describe the principal types of defects that may be encountered, indicate their usual causes, and state how they may be detected and remedied. While most of the report deals with the inspection of welds in ferrous material, there is a considerable discussion of the nonferrous metals, including copper and copper alloys, aluminum and aluminum alloys, and nickel and nickel alloys.

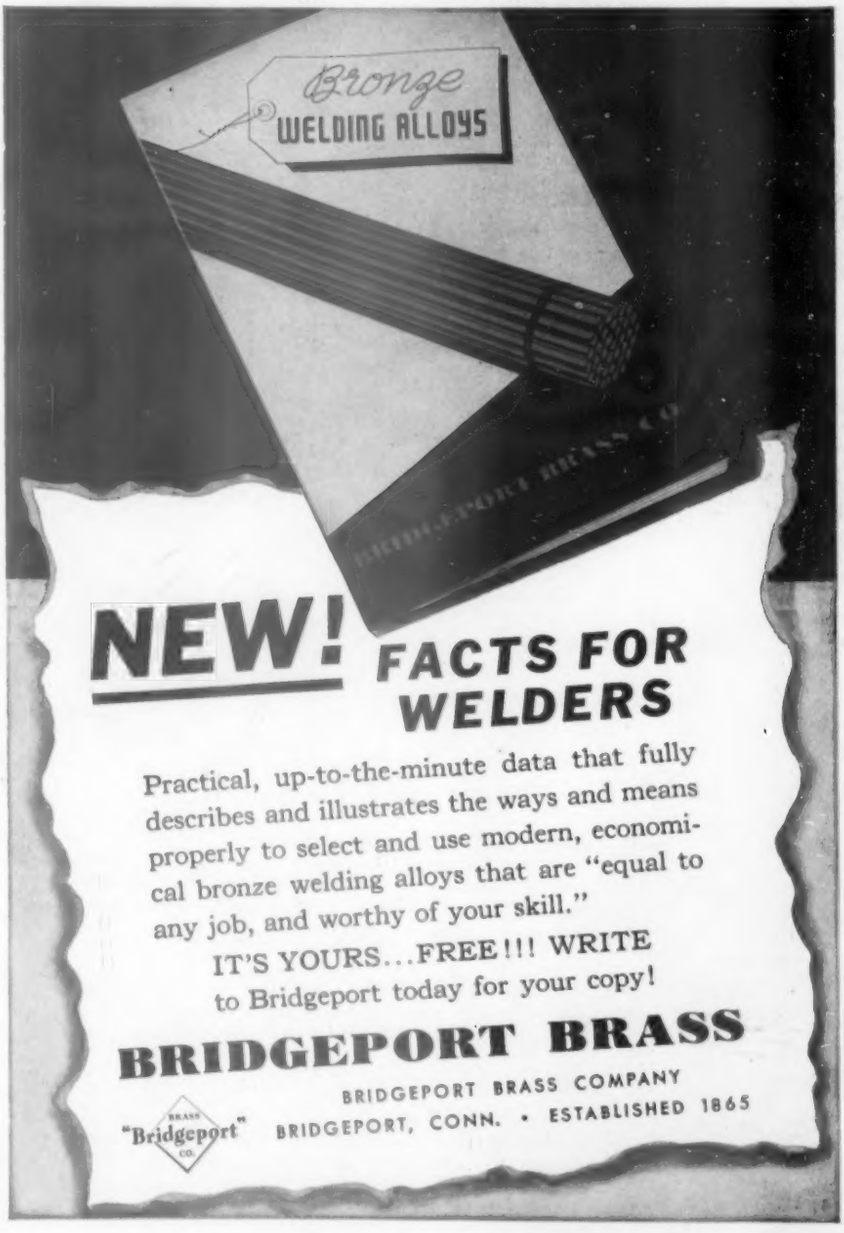
This report is published by the **American Welding Society,** 33 West 39th St., New York, in the form of a 23-page bulletin with a heavy paper cover, available at 40¢ per single copy, with discounts for quantities.

» «

Efficiency Booklet

A booklet on plant efficiency has been published by the Division of In-

(Continued on page 68)


Bronze
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NEW! FACTS FOR WELDERS
Practical, up-to-the-minute data that fully describes and illustrates the ways and means properly to select and use modern, economical bronze welding alloys that are "equal to any job, and worthy of your skill."
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Current Reviews

(Continued from page 67)

formation, War Production Board, called **"Plant Efficiency** — Ideas and Suggestions on Increasing Efficiency in Smaller Plants."

It is in simple terms and is designed primarily for smaller war plants or for plants which are just getting into war production and which might be able to increase production by a study of efficiency procedures.

Chapters in the booklet deal with "Good Lighting—Better Work"; "Cutting Down Accidents"; "Adapting Old Machines to New Jobs"; "Maintenance and Repair"; "Longer Life for Cutting Tools"; "Getting the Most Out of Machine Tools"; "Production Lines Geared for War"; "Meeting Government Standards"; "Training Workers Quickly"; "Swing Shifts"; "Keeping Track of Orders, Production, and Materials"; "Plant Protection"; "Pooling Facilities"; "A Work on Priorities"; and "Getting Into War Work."

Copies may be obtained from regional and local offices of the War Production Board, located in 120 cities; from local offices of the Division of Information, Office for Emergency Management; or by writing to the Division of Information, **Office for Emergency Management,** Washington.

» «

Steel Bulletin

"Selection and Conservation of Alloying Elements Used in Steels" by John Mitchell, metallurgical engineer of the Alloy Division, Carnegie-Illinois Steel Corp., has just been published as No. 6 in the "Contributions to the Metallurgy of Steel" series of the **American Iron and Steel Institute,** New York.

This material was originally prepared for use by metallurgical contact representatives of Carnegie - Illinois Steel as a practical guide to the relative influence of certain alloying elements in steel. It was presented by Mr. Mitchell before several West Coast Chapters of the American Society for Metals.

As published, the paper makes a 57-page booklet, illustrated with 33 diagrams, and includes eight tables. The author's comments are confined to the effects of carbon, manganese, phosphorus, sulphur, silicon, chromium, nickel, molybdenum, vanadium and copper.

» «

Foreign Shipment Instructions

Two additional sections of the **Steel Products Manual,** covering the packaging and shipment of steel products for the Soviet Government Purchasing Commission and China Defense Supplies, Inc., have been released by the **American Iron and Steel Institute,** New York.

The Russian section is a 31-page pamphlet titled, "Packaging, Loading and Shipping Methods for the Soviet Government Purchasing Commission in the U .S. A." The instructions given in this booklet were prepared by the Committee on Packaging, Loading and Shipping Problems of the American Iron and Steel Institute in cooperation with members of the Soviet Commission, the War Production Board, freight handlers and other interested parties.

The Chinese section is a 25-page pamphlet titled, "Packaging, Loading and Shipping Methods for China Defense Supplies, Inc." The instructions were prepared by the Committee named above in cooperation with representatives of China Defense Supplies, Inc., freight handlers and other interested parties.

Both sets of instructions have been approved as standards for use in the steel industry by the United States Treasury Department, Procurement Division.

» «

OD Grinding Primer

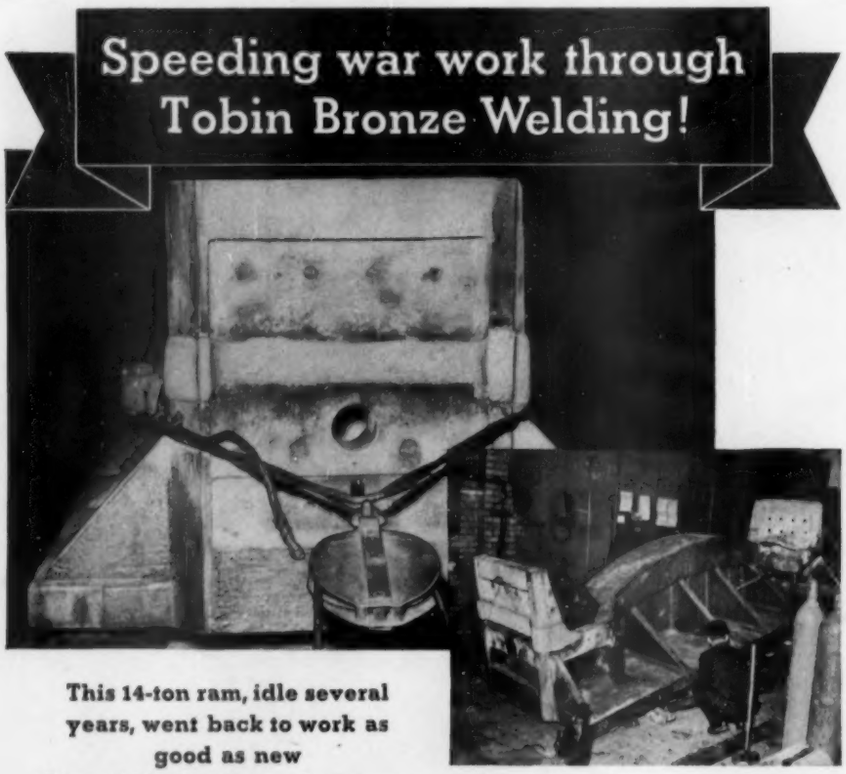
"The A B C of OD Grinding," a 37-page booklet, discusses both cylindrical and centerless outside diameter grinding. Topics included are how to set up the grinding job, how to select the proper grinding wheel for each job and mount it correctly, operating tricks that increase production, selection of abrasive wheels for cylindrical grinding, selection of abrasive wheels for centerless grinding.

This booklet is available from the **Norton Company,** Worcester, Mass.

» «

Machining Monel

The International Nickel Company, Inc., development and research division, 67 Wall St., New York City, announces a revision of its **Technical Bulletin T-12,** "Machining Monel, 'R' Monel, Inconel, 'K' Monel and Nickel." Data on mechanical properties of "KR"



This 14-ton ram, idle several years, went back to work as good as new

Rams of this size take months to manufacture and deliver. So, when this one was found coincidentally with a call from a war job for such a piece of equipment, everyone felt quite happy... for awhile. Inspection revealed a badly patched fracture which probably occurred many years ago.

Undismayed when it examined the ram, the Super Arc Welding Company of Detroit set out to put the equipment into first-class operating condition... by Tobin Bronze Welding. After three days of adjusting the parts, they started preheating and welding. Three days later, with the help of 1750 pounds of Tobin Bronze, this ram went to work on war production.

• • •

Tobin Bronze and other Anaconda Copper-Alloy Welding Rods are always "on call" for war production work. 42971A

ANACONDA *Anaconda Welding Rods*

THE AMERICAN BRASS COMPANY—General Offices: Waterbury, Conn.

Subsidiary of Anaconda Copper Mining Co. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

Monel have been added, and those on various other materials brought up to date. The oversize allowances required to obtain a clean machined finished surface have also been revised. Recommended cutting feeds and speeds for "KR" Monel based on machining practice are likewise included.

Band sawing is discussed. Also added are data on results of drilling tests on cast materials and of tests on precision grinding.

» «

Conduit Catalog

Catalog "S," the Ric-wiL Co.'s new catalog on underground and overhead prefabricated unit and tile conduit system, is just off the press. This 12-page engineering bulletin presents pictorial factory pre-fabrication views and also typical defense plant installations. Write **Ric-wiL Co.**, 1562 Union Commerce Bldg., Cleveland, for a copy.

» «

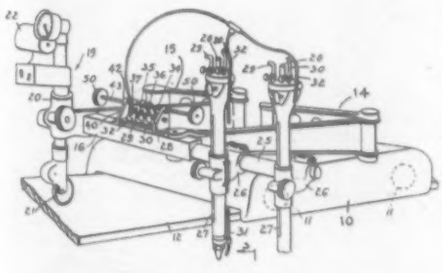
Spot Welder Catalog

Catalog 41 has just been published by the **Pier Equipment Mfg. Co.,** Benton Harbor, Mich.—manufacturers of Ace Spot Welders. This Catalog contains complete description of the various essential elements and the various types of foot-operated and motor-driven automatic welders made. A description of the new Type 47 Automatic Weld Timer for use with any size manually operated Ace Welder is included in this latest edition of the Pier Catalog.

Recent Patents

Flame Cutting Machine

2,284,005. **James D. McKiernan,** Brooklyn, assigned to **Air Reduction Co., Inc.,** New York City. Filed May 1, 1940. Issued May 26, 1942. A flame cutting machine including a wheeled carriage



with a frame for supporting a tracer and torch for universal movement in a plane. Tracer operates over a field between the paths followed by the wheels, and the torch operates over a parallel field on the opposite side of one of the paths. Supply of gas to the torch is controlled by valve and valve-actuator extending transversely of the tracer field. One handle is accessible from the torch side of the tracer field, and another handle is accessible from the other side of the tracer field.

» «

A-C Arc Welder

2,284,323. **Leroy F. Kingery,** Stockton, Calif., assigned to **Shober Sales, Inc.,** Stockton. Filed July 12, 1940. Issued May 26, 1942. An A-C arc welder incorporating a variable reactor for current regulation. The reactor is of a stator and rotor type, having a U-shaped coil-wound core. Various current settings are obtained by means of raising or lowering the rotor in a plane parallel to the stator. Axial movement toward the stator is accomplished manually by means of a screw. The position of engagement between stator and rotor is secured by a locking mechanism on the adjusting screw.

» «

You Help Someone You Know

USO

When You Give to the U S O

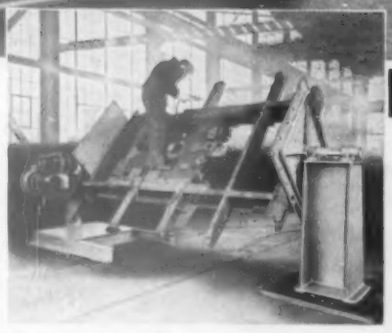
Resistance Welder

2,284,315. **Leonard A. Yoder,** Lakewood, O., assigned to **The Yoder Co.,** Cleveland. Filed Dec. 6, 1941. Issued May 26, 1942. A resistance welding machine for butt-seam welding of tub-

(Continued on page 70)

A

B



A Above is a C-F Positioner rotating a heavy awkward load with a "tailstock." Here is convenient welding, "down-hand" at every point and faster too.

B At the left is a better view of the "tailstock," showing weldment fastened to the platen. This arrangement suggests better welding production for many jobs.

Cullen-Friestedt Positioners equipped with a "tailstock," (a free-turning platen mounted on a suitable stand) permits a complete rotation of heavy awkward weldments so that faster, better down-hand welding may be done. With push-button switch, the welder has complete control of turning speed and starting and stopping at convenient welding positions. Our NEW booklet WP 21 is just off the press giving full information about C-F Positioners in four sizes from 1200 to 14,000 lbs., capacity. Write for it.

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You can now obtain electrodes of chemically pure tungsten, uniform in physical structure, slow burning under the intense heat of the arc. They are straight, clean, true in diameter, all of which helps sustain an even, non-sputtering arc with controlled temperature at the weld.

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Prompt Deliveries on All Standard Electrodes

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VASCOLOY-RAMET CORPORATION
Sole Distributor
NORTH CHICAGO, ILLINOIS
DISTRICT OFFICES IN PRINCIPAL CITIES

Recent Patents

(Continued from page 69)

ing. Unitary mechanism comprises a frame consisting of a main section and axially related separate sections which carry electrodes. Transformer is carried by the main frame section. Spaced pairs of bearings between the support and main frame section are disposed parallel to the common axis of the electrodes and upon opposite sides of the vertical axial plane, for rotatably supporting unitary mechanism.

» «

Butt-Seam Tube Welding

2,283,940. **Howard I. Morris,** Lakewood, O., assigned one-third to **Carl M. Yoder** and one-third to **Harvey O. Yoder,** both of Lakewood. Filed Sept. 5, 1939. Issued May 26, 1942. This patent largely pertains to the mounting of a single phase transformer, primary member of which is fixedly mounted on a stationary support and secondary member of which is rotatably mounted. Disc electrodes are fixedly related to the secondary member of the transformer and rotatable with it.

» «

Butt-Seam Tube Welding

2,283,941. **Howard I. Morris,** Lakewood, O., assigned one-third to **Carl M. Yoder** and one-third to **Harvey O. Yoder,** both of Lakewood. Filed March 1, 1940. Issued May 26, 1942. This patent pertains to a mounting comprising a sectional member, one section of which carries a transformer. The remaining sections consist of conductor devices, each being rigidly attached to the first section. A movable electrode is connected to each conductor device. Spaced bearings on the support engage the section and conductor devices for rotatably supporting the sectional member.

» «

Butt-Seam Tube Welding

2,283,942. **Howard I. Morris,** Lakewood, O., assigned one-third to **Carl M. Yoder** and one-third to **Harvey O. Yoder,** both of Lakewood. Filed Nov. 22, 1940. Issued May 26, 1942. This patent pertains to the combination with a base of a support mounted on and over the base in spaced relation to it. Depending from the support are spaced hangers provided with bearings for rotatably mounting a conductor. A separate conductor is fixedly related to and insulated from the first conductor. Electrodes are rotatable with the conductors and are entirely disposed between the bearings. A single phase transformer has its primary winding fixedly related to the support and secondary winding fixedly related to the conductors and electrically connected to them; the transformer is also entirely disposed between the bearings.

» «

Coated Electrode

2,283,916. **George F. Comstock,** Niagara Falls, assigned to **The Titanium Alloy Manufacturing Co.,** New York City. Filed Sept. 18, 1940. Issued May 26, 1942. A welding electrode comprising 4 to 6% chromium, 1 to 10% titanium, up to 0.1% carbon, and iron, the amount of titanium being at least 10 times the amount of carbon. Electrode is provided with a coating containing a major proportion of calcium fluoride with not more than 5% of substances reducible by titanium at welding temperatures.

» «

Resistance Welding Machine

2,284,851. **Julius B. Tiedemann,** Milwaukee, assigned to **A. O. Smith Corp.,** Milwaukee. Filed Feb. 5, 1937. Issued June 2, 1942. An electric resistance machine with a plurality of electrodes for contacting with the work on one side. Means are provided for moving the electrodes relative to one another, within the tolerances as to unevenness of the work piece, to effect substantially equal pressure engagement of the electrodes with the work.

» «

Electrode Holder

2,283,996. **Samuel James Irwin,** Chester, and **Kenneth M. Irwin,** Coatesville, Pa. Filed May 25, 1940. Issued May 26, 1942. This holder consists of an insulated handle to which is secured a

(Continued on page 72)

For Welding Aluminum

To insure success in welding aluminum, aluminum alloys and Dow metal, use FLUXINE No. 7, which meets Air Corps, Army and Navy "specs". Widely used for welding aircraft parts. It dissolves and floats off oxide coating on metals and rods. Induces fusion at the weld, speeds flow of rod, eliminates porosity, strengthens joint, leaves surface smooth. KREMBS AND CO., 671 W. Ohio St., Chicago, Ill. Chemists and metallurgists since 1875.

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CAST IRON BRAZING FLUX

SPEEDS THE WAR EFFORT

EASIER, FASTER, MORE EFFICIENT BECAUSE OF
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1. Fear of overheating cast iron can be forgotten with "York's 77". Bronze can be applied from a dull red heat up to the molten point of the cast iron.
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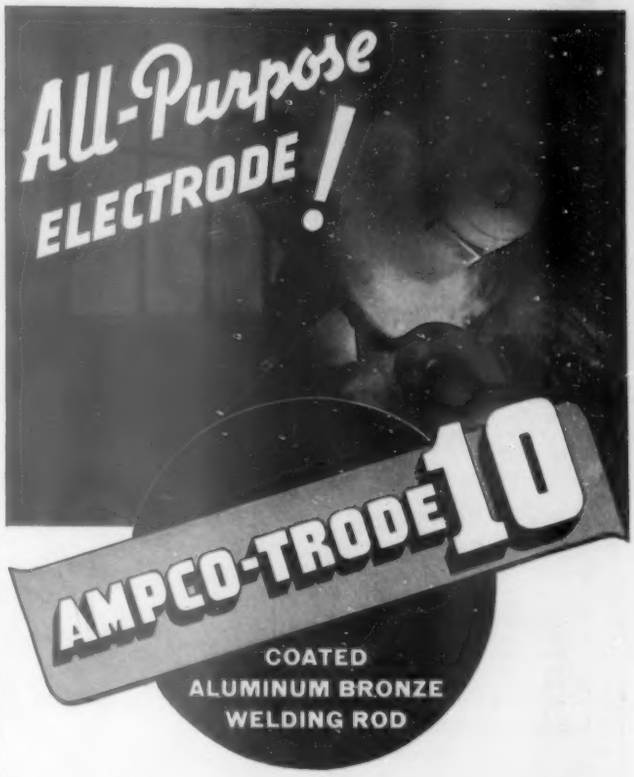

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COATED
ALUMINUM BRONZE
WELDING ROD

Numerous tests and applications prove that this new all-purpose coated-bronze electrode is well suited for welding manganese bronze castings and brass sheets or plates.

Ampco-Trode 10 also welds or "brazes" dissimilar metals:—steel to cast iron; steel or cast iron to bronze, brass, or copper; or any of these metals to nickel alloys.

Its excellent physical properties—high tensile and yield strength plus good elongation—make it an exceptional electrode for such applications. The "hot-ductility" of Ampco-Trode 10 results in welds substantially free from shrinkage cracks.

The Ampco-Trode line of coated-bronze electrodes also includes other rods made of Ampco Metal, having its characteristic high strength, hardness and excellent bearing qualities. Suitable for severe service conditions—shock loading, wear and corrosion resistant applications.

Rods are made in seven sizes, 1/8" to 1/2"; may be used for metallic arc, carbon arc, and oxy-acetylene welding. Literature sent on request.

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Dept. . . . . WR-7 Milwaukee, Wisconsin

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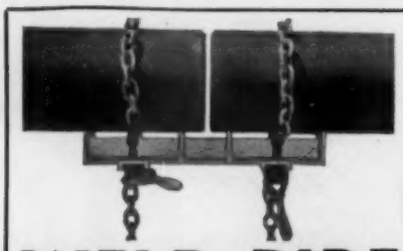

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Weld more pipe in a day with Jewel Pipe Clamps. They keep the welder welding instead of waiting, for it only takes a minute to put them on and set the pipe in perfect alignment.

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ST. PAUL, MINNESOTA

Recent Patents

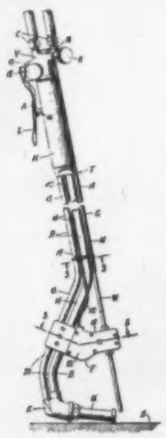
(Continued from page 70)

sleeve. A terminal element is mounted in the handle and extends through the sleeve, the element being normally electrically disconnected from the sleeve. An apertured cap, threaded on the outer end of the sleeve and embracing the end of the element, constitutes the means for clamping an electrode against the extremity of the terminal element, direct contact of cap and the terminal element being prevented.

» «

Flame Deseaming Torch

2,283,932. **Everett P. Jones,** Elizabeth, N. J., assigned to **Oxweld Acetylene Co.** Filed Dec. 21, 1940. Issued May 26,



1942. Straight handle portion of the torch is connected by a tube to a nozzle so that the discharge end of the nozzle is substantially aligned with the axial projection of the handle portion. A guide secured directly against the handle supports a straight wire member in position to extend directly across and adjacent to the discharge end of the torch.

» «

Flame Cutting Machine

2,284,711. **James L. Anderson,** Closter, N. J., assigned to **Air Reduction Co., Inc.,** New York City. Filed May 7, 1940. Issued June 2, 1942. A flame cutting machine for cutting upwardly extending pipes. A clamp with a substantial width grips the pipe. A torch support is held in a definite spaced relation to the clamp and is movable around the clamp's circumference. Three rollers are in contact with the clamp at angularly spaced points around its circumference; all of the rollers on the same side of the pipe as the center of gravity of the torch support are at a different and lower level from the roller on the other side.

» «

Electrode Holder

2,284,648. **Walter T. Foreman,** Petersburg, Va. Filed April 7, 1941. Issued June 2, 1942. A shield for a welding electrode comprising a hollow tinted, substantially transparent globular body and an inwardly projecting guide. The globular body has an opening spaced from and coaxial with the guide. A supporting guide sleeve for electrode is suspended within the body and a coupling stem extended from body.

» «

Welding Flux

2,284,619. **Perez Epstein.** Filed Sept. 14, 1939. Issued June 2, 1942. A flux for welding copper, comprising a heterogeneous mixture of borax 36% by weight, sodium acid fluoride 23% by weight, sodium silico fluoride 19% by weight, antimony fluoride 1% by weight, phosphoric acid 13% by weight, and tri-sodium phosphate 8% by weight.

» «

Resistance Welding

2,286,104. **Henry Thomas Platz,** Detroit, assigned to **Briggs Mfg. Co.,** Detroit. Filed Nov. 1, 1940. Issued June 9, 1942. In this resistance welding apparatus, a cylinder communicates with a source of fluid under pressure through the medium of two passages; a metering valve in one passage regulates the flow of fluid to the cylinder. Within the cylinder, a piston is slidably mounted and connected to an electrode for moving the latter into clamping engagement with the work to be welded under the action of the pressure supplied to the cylinder through the metering valve controlled passage. A valve in the other passage moves to its open position in response to a sufficient pressure rise in the cylinder to engage the electrode with the work.

» «

D-C Welder

2,286,102. **John F. Peters** and **Ralph H. Wright, Edgewood, Pa.,** assigned to **Westinghouse Electric and Mfg. Co.,** East Pittsburgh. Filed Feb. 23, 1939. Issued June 9, 1942. This patent pertains to the parallel operation of D-C welding machines. The several D-C generators are connected in parallel circuit for supplying current to a work circuit. A driving motor operates each

(Continued on page 74)

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No. 406 Helmet has standard glass holder without lift-front feature.

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Quality Control in manufacture of TITAN Welding Alloys begins with the selection of the finest available raw materials.

Only the purest raw materials are used: Electrolytic copper 99.96 plus in purity, and electrolytic zinc 99.99 plus. This assures the elimination of elements which if introduced would prove detrimental to quality and uniformity.

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Descriptive literature sent upon request

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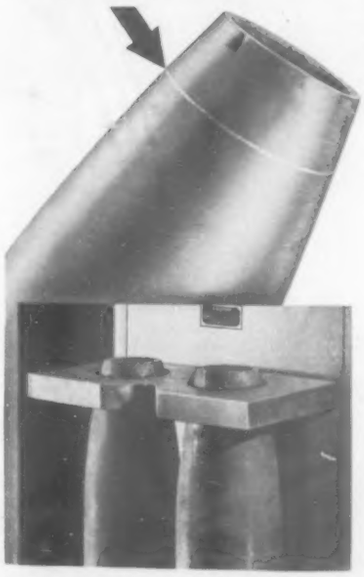
TITAN WELDING RODS



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Here's another case where **strong, sound joints*** brazed with EASY-FLO plus a procedure designed to facilitate handling and heating have speeded up production.

THE JOB—Making leak-tight joints between steel adapters and steel bodies of 75, 81, 105 and 155 mm. shells.

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FOR FULL DETAILS ABOUT EASY-FLO WRITE FOR BULLETIN No. 12

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Recent Patents

(Concluded from page 72)

generator. Generator output is regulated by means of excitation windings. A relay, responsive to changes in the input current of a driving motor relative to the total input current of the driving motors, effects operation of the regulator to maintain a predetermined division of the load current between the generators. Additional regulation is provided for collectively controlling the excitation of the generators to maintain a predetermined load current.

» «

Thermit Welding Apparatus

2,286,075. **Walter R. Evans,** Bartlesville, Okla., assigned to **Phillips Petroleum Co.** Filed Jan. 21, 1941. Issued June 9, 1942. For welding a well casing in place by means of thermit. The receptacle includes a heat-resistant base, a shell extending upwardly from the base, a heat-resistant material on the inside of the upper portion of the shell and a heating element within the receptacle. Means is provided for effecting an adequate seal between the receptacle and the inner surface of the well casing.

» «

Automatic Arc Welder

2,286,028. **Frank B. Tuttle,** Schenectady, N. Y., assigned to the **General Electric Co.** Filed Jan. 30, 1942. Issued June 9, 1942. Apparatus comprises a plurality of circuits, in each of which is connected a pair of electrodes. Electrode feed is controlled by synchronous timing.

» «

Cutting Torch

2,285,496. **Herbert W. Cowin,** Westfield, N. J., assigned to **The Linde Air Products Co.** Filed Nov. 29, 1938. Issued June 9, 1942. A torch adapted for

use in cavities and other confined places. A slender, elongated tubular casing extends from the torch head and surrounds the oxygen supply line. Head is located within the axially-projected periphery of the tubular casing and has a recessed lateral face provided with a cavity angularly disposed relative to the axis of the casing. Cutting tip is mounted in the cavity. Delivery end of the tip has a cutting oxygen orifice and at least one preheating gas mixture orifice. Tip lies wholly within the axially-projected periphery of the casing, which guides the tip within cavities and spaces the delivery end of the tip from the walls of such cavities.

(Continued on page 76)

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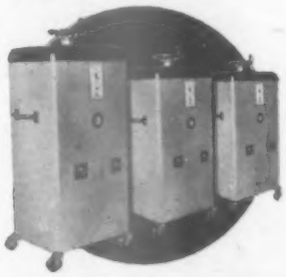

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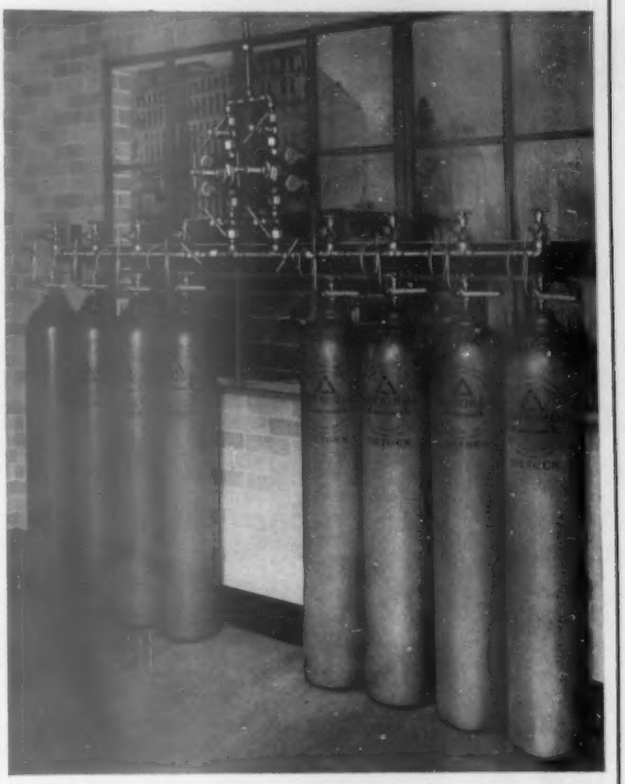

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Recent Patents

(Continued from page 74)

Multiple Spot Welder

2,286,945. **Velorus E. Andrews,** Teaneck, and **Arthur C. Schanz** and **John W. Sheffer,** Glen Ridge, N. J., assigned to **American Car and Foundry Co.,** New York City. Filed March 4, 1941. Issued June 16, 1942. This resistance welding machine provides means for supporting and intermittently moving material to be welded through the machine. Welding is done by multiple electrodes, arranged in groups extending longitudinally and transversely of the path of movement. The electrodes are simultaneously moved toward and away from the material to be welded, and each group is also selectively moved along the material after a weld. Fluid pressure is used to force the electrodes into contact with the material to be welded. Flow of welding current successively to the electrodes is controlled by switch means.

» «

Aluminum Soldering Flux

2,286,298. **Mike A. Miller,** New Kensington, Pa., assigned to **Aluminum Co. of America,** Pittsburgh. Filed Sept. 8, 1941. Issued June 16, 1942. A method of increasing the activity of a soldering flux containing at least two boron-fluorine-containing compounds, one of which is a heavy metal fluoborate and the other an acidic boron-fluorine-containing compound, and at least one amine selected from the group of amines consisting of aliphatic poly-amines and aliphatic amino-alcohols. A relatively small amount of actifying ammonia is introduced in the flux, which is afterwards heated to about 50 C, but below the temperature of decomposition of any portion of its amine component.

» «

Tube Welding Method

2,286,210. **Hans Klemperer,** Belmont, and **Laurence K. Marshall,** Cambridge, Mass., assigned to **Raytheon Mfg. Co.,** Newton, Mass. Filed Jan. 14, 1941. Issued June 16, 1942. A method of arc welding inside a pipe. The source of the arc is derived by induction from high frequency coils. The arc is struck inside the tube and maintained between the walls of the tube. By means of a magnetic field, the arc is moved rapidly along and throughout the predetermined length of the weld. A control of the magnetic field is provided to control the speed of travel of the arc.

» «

Tube Welding Method

2,286,211. **John W. Dawson,** Auburndale, and **Laurence K. Marshall,** Cambridge, Mass., assigned to **Raytheon Mfg. Co.,** Newton, Mass. Filed Oct. 11, 1940. Issued June 16, 1942. A method of arc welding within a tube. The arc is created between the walls of the tube and extended throughout a predetermined length of wall. This patent pertains largely to a means for establishing in the gap a magnetic field substantially stationary with respect to the gap and having a substanial component at right angles to the length of the gap. The magnetic field causes the arc to travel rapidly along and throughout the predetermined length, heating the wall along its course to welding temperature.

» «

Tube Welding Method

2,286,212. **Elmer J. Gorn,** Brookline, Mass., assigned to **Raytheon Mfg. Co.,** Newton, Mass. Filed March 15, 1941. Issued June 16, 1942. A machine for arc welding together two annular members along their end walls. An electrode is held adjacent the end walls of the members, being separated from each of the end walls by a gap. A means is provided for striking an arc between the electrode and each of the end walls, and for maintaining these arcs while the electrode and walls are held separated. A means is also provided to move each of the arcs along the end walls, heating them rapidly through out their peripheral extent. Pressure is applied to the heated end walls to cause them to become welded to each other.

» «

Cutting Torch for Minerals

2,286,191. **Robert B. Aitchison,** Staten Island, and **Charles J. Burch** and **Charles W. Swartout,** Kenmore, N. Y., assigned to **The Linde Air Products Co.** Filed April 18, 1939. Issued June 16, 1942. A process for cutting and piercing a solid body of mineral or like material by means of flame heat. The stream of fuel gas carries in suspension finely-divided combustible metal; fuel gas is surrounded by a separate flowing body of combustion-supporting gas. The gas mixture and metal are burned, producing intense heat and disintegrating an adjacent zone of the mineral body. The torch is then advanced within the mineral body to similarly produce heat adjacent successive zones and progressively disintegrate them. Disintegrated portions are removed by a flowing stream of an ejection fluid.

» «

Seam Welding

2,287,540. **Alfred Vang,** Detroit, assigned to **Clayton Mark & Co.,** Evanston, Ill. Filed August 12, 1940. Issued June 23, 1942. This patent pertains to an electric circuit for fusing a partially contacting juncture between conducting materials by means of high frequency alternating current. The circuit consists of the materials to be fused, electrodes contacting them, a capacitor, a means of charging the capacitor, and an electronic control capable of passing the high frequency current which is established upon discharge of the capacitor.

» «

Discharge Tube

2,287,541. **Alfred Vang,** Detroit, as-

(Continued on page 78)

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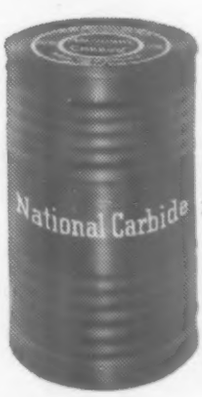

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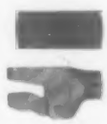

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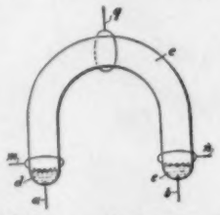
J. LESLIE KINCAID, President

Recent Patents

(Continued from page 76)

signed to **Clayton Mark & Co.**, Evanston, Ill. Filed Nov. 7, 1940. Issued

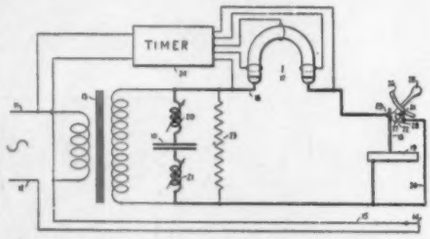


June 23, 1942. A discharge electronic tube with an envelope of insulating material formed in the shape of an inverted U. A mercury electrode is at each end of the envelope, these electrodes being connected to an outside circuit. Near each mercury electrode, an ignition electrode is located outside the envelope, and a control grid is also located outside the envelope, halfway between the mercury electrodes.

» «

Stored Energy Arc Welding

2,287,543. **Alfred Vang,** Detroit, assigned to **Clayton Mark & Co.,** Evanston, Ill. Filed Dec. 18, 1940. Issued June 23, 1942. This method of electric arc welding comprises discharging a capacitor through electrodes in timed relation to the charging of the con-



denser. Timing is effected by means of a bi-directional electronic discharge device.

» «

Stored Energy Resistance Welding

2,287,544. **Alfred Vang,** Detroit, assigned to **Clayton Mark & Co.,** Evanston, Ill. Filed Feb. 25, 1941. Issued June 23, 1942. A method of spot welding through a single discharge of electric current sufficiently heavy to cause an arc within the air spaces between materials to be welded. The current is supplied through spot welding electrodes, applied to the materials with relatively light pressure, and is of such brief duration as to penetrate the materials only sufficiently to form a shallow weld between them.

» «

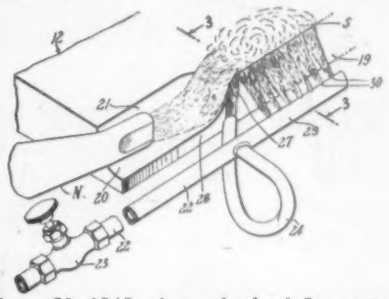
Galvanizing Compound

2,287,227. **Clinton Bowsher,** Lima, O., assigned to **The Artkraft Sign Co.,** Lima, O. Filed April 12, 1941. Issued June 23, 1942. An alloy having a melting point of less than 850° F and adapted to be spread, when applied as a cold stick, to a heated metal surface to form a homogeneous coating which tenaciously adheres to the metal surface. The alloy comprises by weight approximately 6½ to 22 parts zinc, 7¼ parts bismuth, 12½ parts tin, ¾ part metallic mercury and 57¼ to 73 parts lead.

» «

Flame Machining

2,287,103. **Everett P. Jones,** Elizabeth, N. J., assigned to **The Linde Air Products Co.** Filed April 3, 1940. Issued



June 23, 1942. A method of flame machining in which metal is removed from the vertical surface of a metallic body to produce a J-groove. An oxidizing gas stream is directed substantially toward the successive portions of metal to be removed while another stream of gas is directed upwardly against the surface to insure that the flow of molten slag from the groove proceeds in an upward direction. Both the oxidizing gas stream and the slag-directing stream are maintained in their relative positions while being moved along successive portions of the surface.

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